



Seabuckthorn On The Way Between Science And Industry Interaction

ОБЛЕПИХА – НА ПУТИ ОБЪЕДИНЕНИЯ
НАУКИ И ПРОИЗВОДСТВА



Барнаул 2009

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BREEDING / GENETICS / ECOLOGY

СЕЛЕКЦИЯ / ГЕНЕТИКА / ЭКОЛОГИЯ

TO THE HISTORY OF SEA-BUCKTHORN INTRODUCTION INTO CULTURE

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Altai territory, republic Altai, the Buryat republic has a rich genofund of sea-buckthorn (*Hippophae rhamnoides*). In flood-lands of mountainous rivers valuable ecotypes of this species grow. Since oldest times Siberians used wild sea-buckthorn berries for eating. For the first time, the scientists of Krasnoyarsk fruit-berry station tried to develop sea-buckthorn varieties, they isolated selective forms, but the forms were lost because of the missing of propagation methods. Wild forms, well-adapted to local conditions, were the base for development of the varieties and introduction of sea-buckthorn into culture by scientists of Lisavenko Institute. It was possible only after the development of winter-resistant, yielding varieties, working out of propagation and cultivation technologies in gardens.

In 1949 vitamin's plant (now Ltd "Altaivitamins") has been built, producing medicinal preparations from sea-buckthorn. Wild forms could not satisfy the requirements of the plant in raw materials. So the task was to develop the varieties and commercial sea-buckthorn plantations. Taking into account recommendations of I.V. Michurin to use winter-hardy wild fruit and berry plants, in 1933 M.A. Lisavenko began to carry out sea-buckthorn breeding in Altai, gathering seeds of the best forms of katunskiy ecotype and seeding them down in 1934. Among the seedlings of seeding-down of 1934-35 the first selective forms were isolated by F. Shein (they were lost), in 1950 – by J. Gatin, three of them became the first varieties in the

world – Dar Katuni, Novost Altaya, Zolotoy Pochatok. Since 1954 investigations in sea-buckthorn breeding are being carried out at the RIHS under the leadership of the academician M.A. Lisavenko and since 1968 – under the leadership of I. Kalinina on a large scale, J. Gatin (1954-1964), E. Panteleeva (since 1959 up to the present), U. Zubarev, E. Oderova, A. Gunin. Since 1956 investigations in biochemistry and processing technology of sea-buckthorn berries are being carried out. Since 1958 geographically remote hybridization is used in breeding, as well as chemical and radiation mutagenesis, cytological and biotechnological methods.

In all 44 varieties (5 jointly with the scientific-workers of Krasnoyarsk and Minusinsk experimental stations) are developed at the RIHS, 29 of them are distributed in Russia in different years. At present 22 varieties of the Institute are in State list of RF, 9 new varieties are on state variety-trials. We managed to develop winter-hardy, early-ripening varieties, thornless or weakly thorny, large-fruited, with high content of oil (up to 7-8%), carotenoids (up to 48 mg %), dessert sweet-fruited, with the yield of 12-38 t/ha (disposition diagram – 4 x 1 m). We carry out breeding on early-ripening and late terms of ripening, on resistance to sea-buckthorn fly, gall mite, drying, on availability to machine harvesting.

The most harmful sea-buckthorn pests and diseases were found out by scientific-workers of the plants protection department under the leadership of M. Prokofjev and L. Shamanskaya, measures of fighting with them are worked out. Agrotechnics department under the leadership of S. Khabarov studied and suggested rational disposition diagrams of plants in gardens, forms and methods of watering, the system of keeping soil in a good state in gardens, application of herbicides in fighting with weeds in nurseries and fruit-bearing plantations. It is stated, that there's a possibility to get the yield up to 48 t/ha, using slope firths and dense plantings. Investigations in sea-buckthorn machine harvesting are being carried out (since 1973), experimental specimen of sea-buckthorn harvesting machine is worked out. Since 1978 we cooperate with the Finnish firm "Ioonen" in completing the Finnish berry-harvesting machine for sea-buckthorn harvesting.

Scientific works of the Institute are introduced into production. More than 20 millions seedlings are grown in nurseries of RIHS and

we have 7 thousands hectares of sea-buckthorn plantations. In 1960, 1964, 1967 the Soviet of ministers of RF adopted the decree on creating of the raw materials source for vitaminic and pharmaceutical industries in Russia, particularly in Altai. In 1961, 1969 on the base of RIHS the first All-Russian meetings on sea-buckthorn were held, which were of great importance for increasing of plantations. In 1993 in Altai the 2-nd international symposium on sea-buckthorn with the participation of the scientists of Russia, Byelorussia, China, Nepal and others was held. Successful work of the scientists of RIHS contributed to the development of investigations on sea-buckthorn in research institutions of Russia, Byelorussia, Azerbaijan, Latvia, in countries of Western Europe, Asia and Northern America. Since 1980 representatives of 28 countries of the world visited the Institute: Germany, China, Japan, India, Mongolia, Canada, USA, Great Britain, France, Sweden, Poland, Finland, Bulgaria, Hungary, Nepal and others.

We are glad that the work of M.A. Lisavenko RIHS contributes to the development of sea-buckthorn investigations. We are ready to cooperate with the participants of the present congress on the base of mutual contracts and agreements, widely introducing this polyvitaminic crop in the name of the people's health of the whole world.

К ИСТОРИИ ВВЕДЕНИЯ ОБЛЕПИХИ В КУЛЬТУРУ

И.П. Калинина

НИИСС им. Лисавенко, Барнаул, Россия

Представлены начальные этапы селекционного процесса по облепихе в России. Обозначены наиболее значительные вехи в становлении облепиховой отрасли на Алтае. Уделено особое внимание роли НИИСС имени М.А. Лисавенко в продвижении культуры облепихи в России и за ее пределами. Перечислены ученые института, внесшие заметный вклад в копилку знаний по облепихе.

DEVELOPMENT OF EST-SSR MARKERS IN SEABUCKTHORN

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Seabuckthorn has attracted plant science researchers from all over the world because of its high nutritional, environmental and medicinal values. Much of the work has been done to study the geographical distribution and develop improved cultivars through plant breeding. Studying the extent and distribution of genetic diversity of seabuckthorn will provide better selection of plants for breeding. DNA polymorphism based approaches have been frequently exploited to probe the genetic variation of species and to understand the genetic relationships among and within species or populations. Though various molecular markers have been used by plant researchers to understand intra- and inter specific genetic diversity in seabuckthorn, but the taxonomical classification of this genus and the relationship among its taxa still remains controversial. Despite having many advantages over other molecular marker systems, little efforts have been made towards developing SSR markers for seabuckthorn. Here we report the utility of EST sequences for development of SSR markers which is a rapid and easy way of developing microsatellite markers. We screened 1584 unigene sequences developed in our laboratory using a microsatellite search tool, MISA, for the presence of SSRs. A total of 56 unigenes showed the presence of microsatellites. Out of these 56 EST-SSRs we have screened 8 primer pairs to look for polymorphism in 15 seabuckthorn accessions representing 3 species (*H. rhamnoides*, *H. sacifolia*, and *H. tibetana*) obtained from DIHAR, Leh, India. Other EST-SSRs are under study for their utility. Since only 9 genomic microsatellites are available till date for seabuckthorn, these EST-SSRs may prove very useful for genome analysis. We plan to use these EST-SSRs for screening biodiversity of seabuckthorns in India.

РАЗРАБОТКА EST-SSR МАРКЕРОВ ОБЛЕПИХИ

Анкит Джайн, Раджеш Гангал и П.С. Шарма

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Приведены результаты исследований по разработке SSR маркеров для облепихи. Показано, что использование EST последовательностей при производстве SSR маркеров является наименее затратным и быстрым способом получения микросателлитовых маркеров. На основе анализа 1584 унигенных последовательностей 56 унигенов показано наличие микросателлитов. Отобрано восемь пар праймеров для изучения полиморфизма трех видов облепихи. Результаты исследований планируется использовать для оценки биоразнообразия облепихи в Индии.

INVESTIGATION OF SEABUCKTHORN BERRIES OF "FORGOTTEN" CLONES AND SELECTIONS OF 1980'S GERMAN BREEDING PROGRAM

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The commercial cultivation and exploitation of Sea Buckthorn berries for high quality food products and cosmetic needs varieties with high values of primary and secondary compounds. In the early 1980's in East Germany a selection and breeding program starts under the management of Hans Joachim Albrecht from Berlin Baum-schulenberg. Some of the commercial results of these breeding program are the well known varieties like f. e. Leikora and Hergo and the new varieties Habego and Sirola. However exist different interesting breeding results with no commercial use in the moment. NIG

has analysed the berries of these unknown clones in two different years with view on industrial use in the food industry. The presented poster will give an overview about the origin of the clones and analysed components, like acid spectrum, vitamin C, flavonoid and oil content and discussed a possible suitability for commercial plantations based on agro technical figures.

Key words: seabuckthorn, breeding, vitamin, flavonoids, berries

ИЗУЧЕНИЕ «ЗАБЫТЫХ» СОРТООБРАЗЦОВ ОБЛЕПИХИ НЕМЕЦКОЙ СЕЛЕКЦИИ 80-Х ГОДОВ

Хайдемари Вернер, Аксель Велинг

Магдебург, Германия

Представлен обзор происхождения исследуемых сортов образцов и анализируются изучаемые параметры, такие как кислотный состав, содержание витамина С, флавоноидов, масла, а также рассматривается возможность использования облепихи для коммерческих плантаций.

PROPORTIONS OF FRUIT BEARING TREES OF ARTIFICIAL SEABUCKTHORN FOREST IN SOFT SANDSTONE AREA

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Seabuckthorn (*Hippophae rhamnoides* ssp. *sinensis*) is a very suitable shrub in the northern China especially in the Soft sandstone areas (SSA) in the adjacent Shanxi, Shaanxi, and Inner Mongolia of

China. It has been planted for more than twenty years in China under the government orderly plan, careful design and active management. The benefits both at ecology and economy have been achieved in the areas which play a key role to increase farmers' and enterprises' incomes, and benefit a lot for a harmonious society construction in China. The proportion of fruit bearing (PFB) is very important for the rehabilitation with seabuckthorn in SSA. Survey and statistics for 36 kinds of artificial seabuckthorn forest shows that the PFB averages 26.9%, with a extension from 9.2% for three to four years' trees to around 30% for six to eight years' trees. The PFB for the trees in alluvium, sand soil, and loess sites is about 30% whereas that of the forest in the soft sandstone site condition is only 22.7%. Rigorous site conditions in the research area causes the low proportions of fruit trees. According to the statistics, economic or eco-economic types of seabuckthorn forest or cash forest should be set up in good site conditions like the bottomland in wide valley for economic benefits, while the ecological type of seabuckthorn forest in bad site conditions for ecological benefits consideration.

Key words: proportion of fruit bearing (PFB); soft sandstone area (SSA); seabuckthorn; artificial forest; forest age; site condition

СООТНОШЕНИЕ ПЛОДОНОСЯЩИХ ДЕРЕВЬЕВ ИСКУССТВЕННЫХ ОБЛЕПИХОВЫХ ПЛАНТАЦИЙ В РЕГИОНЕ ЛЕГКИХ ПЕСЧАНИКОВ

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Облепиха (*Hippophae rhamnoides ssp. sinensis*) широко используется в северном Китае, особенно в регионах легких песчаников Шанси, Шаанси, внутренней Монголии Китая. Статистический анализ 36 искусственных облепиховых зарослей показывает, что число плодоносящих деревьев зависит от возраста, почвенных условий и в среднем составляет 26,9%.

FUNCTION OF ARTIFICIAL SEABUCKTHORN FOREST ON SOIL AND WATER CONSERVATION AND ECOLOGY IN SEMI-ARID LOESS HILLY REGION

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Due to serious soil erosion and less precipitation (annual rainfall 508 mm in studied region), most arbor and shrub tree species couldn't be afforested in the semi-arid loess hilly region. Seabuckthorn is regarded as one of few shrub species which could grow well in the region. The objective of this study was to assess the changes with time in soil and water loss and soil moisture following the growth of afforested seabuckthorn in the region. By means of long-term positional monitoring and analysis in laboratory located in Ansai county, Shaanxi province, the results have been showed that Annual average intercepting rate of canopy on rainfall at 5-12 ages is about 10.5%, intercepting maximum of litter layer at 5-12 ages is 0.93 mm in individual rainfall, soil infiltration and anti-scourability could be improved, with the changes of soil physicochemical properties in seabuckthorn forest, which are mainly decided by the number of hair roots and depth of litter layer. Effect of seabuckthorn forest on soil and water conservation becomes much stronger with tree ages increasing. At 2-3 ages, the decrease of runoff and sediment by the forest is much less and the changes lie mainly on the characteristics of rainfall, annual runoff depth and sediment discharge are 7.2-9.4mm and 387.97 t.km⁻² respectively, 1.8~3.2mm and 24.64 t.km⁻² respectively when seabuckthorn forest is becoming into forest establishment at 4-5 ages, runoff and sediment discharge are decided jointly by rainfall and the forest, 0.3-3.4mm and 0-6.75 t.km⁻² respectively when it is in formation period at 6-12 ages, effect of rainfall on

them is much less and the forest structure characteristics plays a decisive role. Sediment charge in runoff reduces sharply at 2-5 ages, the value ranges from 77.31 kg.m⁻³ to 9.12 kg.m⁻³, tends to stable at 6-12 ages and the value 0-5.09 kg.m⁻³. In growing season (April-October), average soil moisture of 0-500cm depth is 5.1%, the lowest in May and the highest in October for 10 ages seabuckthorn forest. Annual soil water consumption in seabuckthorn forest increases with ages increasing, 8 ages seabuckthorn forest has consumed 231.2mm of soil stored water in 0-500cm layer annually and average soil moisture is 5.6%. Therefore, it should be stumped at 8 ages for soil moisture increasing. In end of the third growing year of stump, average soil moisture can recover in 0-160cm depth and the value is 10.3%-14.6%.

Key words: Artificial seabuckthorn forest; loess hilly region; soil and water conservation; soil moisture

ВЛИЯНИЕ ИСКУССТВЕННЫХ ОБЛЕПИХОВЫХ НАСАЖДЕНИЙ НА СОХРАНЕНИЕ ВОДНЫХ И ПОЧВЕННЫХ РЕСУРСОВ В ПОЛУПУСТЫННЫХ РЕГИОНАХ

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Проведена оценка влияния искусственных облелиховых насаждений на плодородие почв и сохранение влаги в полупустынных регионах Китая.

STUDY ON INTRODUCTION OF FINE SEABUCKTHORN SPECIES FROM RUSSIA

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The loess plateau is the distribute center of the Chinese Seabuckthorn subspecies. Now Seabuckthorn forest in large area has been planted in this region. It is generally wildlife plant forms having the characteristics of small fruit, more thorns, difficult harvest and low fruit output. We had undertaken the “948” project assigned by Ministry of Water Resources – Introduced Russian seabuckthorn varieties, and a cooperation research project between China & Russia in 1997-2006. In order to solve the problem of deficient in fine seabuckthorn species in the area of northwest, northeast and north China (the three north area, including the loess plateau), through the experiment of 8 years, more 20 chief species and forms of seabuckthorn had been introduced in this area from Russian. We have tentative selected 9 fine Seabuckthorn species and forms in the 7 experiment base in the “three north area” and loess plateau. They have characters of fine growth, resistibility and the higher fruit yield. We have begun breed the crossbred varieties of a new generation through crossbreed of Russian seabuckthorn with Chinese seabuckthorn. On the basis of introduction, selection and breeding of seabuckthorn, we have made to experiment, example and popularizing work on the intensive cultivation and breed good strains. It has produced good ecological, economical and social benefits. On the basis of the introduction experiments and investigation on its introduction results in part regions of “tree north area” and loess plateau and other regions of China, as well as the analysis on the distribution of ecological fac-

tors, as water, heat, the principles of division of ecological regions of introduction seabuckthorn from Russia, 4 ecological regions has been advanced. They are: suitable region; sub-suitable region; the region of possible to introduction; non-suitable region of introduction. It is important work to breed and introduce the crossbreed species of Russian seabuckthorn with Chinese seabuckthorn in the loess plateau. Through this project implementation, the better introducing results had been obtained. It will provide reliable scientific basis for carrying on introduction, selection and breeding of seabuckthorn step by step in a planned way. It has important significance for constructing large-scale of high production and quality seabuchthorn forests and garden, and rapid harnessing environment of the “three north” and loess plateau area, and developing local economy.

Key words: Seabuckthorn; Introduction; Russia

РЕЗУЛЬТАТЫ ИНТРОДУКЦИИ ЛУЧШИХ РОССИЙСКИХ СОРТООБРАЗЦОВ ОБЛЕПИХИ В КИТАЕ

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Более 20 видов и форм российской облепихи были изучены в Китае в рамках международного российско-китайского проекта. Лучшие образцы были включены в селекционный процесс с местными подвидами облепихи. Проведено ранжирование территорий по пригодности для возделывания исследуемых сортов образцов облепихи.

IDENTIFYING AND CHARACTERIZING ANTIFREEZE PROTEINS IN APOPLASTOME OF SEABUCKTHORN SEEDLINGS

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Apoplast is the extracellular space in between cell membrane and cell wall. Although it physically separates the cell from the external environment but it also forms a communication channel between the two. Apoplast contains a lot of bio-molecules including amino acids, hormones and proteins. It is a very dynamic part but unfortunately is not well characterized. It plays important role in long distance signalling which is very important for all signalling pathways controlling plant growth and development and also in responding to biotic and abiotic stresses. It is very well documented in rye that antifreeze proteins are secreted in to the apo-plast. Therefore a search for similar protein was initiated in Seabuckthorn (*H.rhamnoides*), which is a cold hardy shrub. Procedures were optimized for growing seabuckthorn seedlings in controlled lab conditions and also for protein extraction. Cold/freezing induced differential expression of proteins was analysed on SDS-PAGE and 2D gels. Proteins identified by MALDI-TOF and LC-tandem mass spectrometry (MS/MS) included antifreeze proteins like chitinase, napin, lipid transfer proteins, thioglucosidase, thioredoxin and triose phosphate isomerase. Out of these chitinase is a very interesting candidate as it is induced by both biotic as well as abiotic stresses. Primers of chitinase are designed to get the amplicon for this from seabuckthorn. Its expression analysis would be taken up to understand its regulation. It would also be cloned in *E.coli* for protein over-expression and its antifreeze properties would be analysed. These investigations would help us in understanding the molecular basis/mechanism of cold tolerance in seabuckthorn. In addition, potential application of these antifreeze proteins in crop improvement programmes, food industry and bio medicine would be discussed.

Key words: apoplast, antifreeze proteins, seabuckthorn, MALDI- TOF, Tandem MS

**ОПРЕДЕЛЕНИЕ И ХАРАКТЕРИСТИКА
АНТИФРИЗОВЫХ ПРОТЕИНОВ
В АПОПЛАСТОМАХ СЕЯНЦЕВ ОБЛЕПИХИ**

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Представлены результаты идентификации антифризовых протеинов в апопластомах облепихи. Установлено наличие целого ряда подобных веществ. Разработаны праймеры для хитиназы. Проведенные исследования помогают понять молекулярную основу и механизм устойчивости облепихи к низким температурам. В работе обсуждаются возможные пути применения антифризовых протеинов в селекционных программах, пищевой промышленности, биологической медицине.

**GENETIC VARIATION ANALYSIS
AND FINE FEMALE PLANTS SELECTION
IN THE FIRST FILIAL GENERATION BETWEEN
RUSSIAN'S VARIETIES AND SINENSIS**

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Russian's selected varieties have many advanced features on economy and biology in native provenance such as big fruit, long stalk, high yield, less thorn and high content of oil from the point of processing. There are much different preference among clones which were introduced from Russian during the 90's last century in Inner

Mongolia. In the Heilongjiang province with cold and wet climate, the introduced varieties can grow well, even though with smaller berries and lower yield compared with those in native places. Under the eco-condition with hot and dry climates in north of China, there are a great influence to its growing and fruiting with the smaller berries and yields. The *sinensis* mainly distributed in north and north-west of China, has a significant difference on features of biology and ecology compared with introduced Russian's varieties, such as the adaptability to eco-conditions, fruit size and mature time, average weight of 100 berries, and so on. The *sinensis* is with better adaptation to dry climates, smaller berries, longer time for mature, and 15g of 100 fruits, very short stalk and more thorns, but high contents of bio-substances, otherwise the Russians' are with relative antitypes. So there is a great significance for crossing breeding by sub-species of *sinensis* and *mongolica*.

Key words: Seabuckthorn; Female Plants Selection; Russian's Varieties

СОРТОИЗУЧЕНИЕ И ГИБРИДОЛОГИЧЕСКИЙ АНАЛИЗ ПЕРВОГО ПОКОЛЕНИЯ ГИБРИДОВ МЕЖДУ РОССИЙСКИМИ И КИТАЙСКИМИ СОРТАМИ

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В материале рассмотрены хозяйственно-биологические признаки сортов российской селекции при интродукции их во Внутреннюю Монголию (Китай), провинцию Хэйлундзян, а также приведено сравнение с местным подвидом облепихи – *H. rhamnoides sbsp. sinensis*. Доказана целесообразность вовлечения в селекционный процесс всех исследуемых подвидов.

UNDERSTANDING THE ROLE OF SEABUCKTHORN IN SOIL FERTILITY IMPROVEMENT IN CENTRAL HIMALAYA, INDIA

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India

The present study investigated to compare the soil physico-chemical properties under two different land uses *i.e.* *Hippophae* growing stand and non-*Hippophae* growing stand. The sampling site was located at Hanumanchatti in Mana Valley of Uttarakhand Central Himalaya in India. A 2 meter mesh square grid (20x20m) was installed in both stands. Within the regular grid, three locations (A, B and C) about 2 m² were chosen for carrying out soil sampling. Quarterly three sampling (0-10cm, 10-20cm and 20-30cm) were systematically done from three locations, within a 25x25 cm frame, using a 20 cm² corer. It was observed that the mean soil moisture percentage of non-*Hippophae* growing stand was found comparatively higher than the *Hippophae* growing stand. Soil pH of *Hippophae* growing stand and non-*Hippophae* growing stand (area) ranged between 6.23±0.27 to 6.73±0.07 hence, indicated the acidic (pH>7.0) nature of soil. The present study highlighted that the organic carbon concentration in the soil was significantly (p<0.05) improved by the *Hippophae* plants. The soil nitrogen ranged between 0.15±0.09 to 0.71±0.28 % (*Hippophae* stand) to 0.07±0.05 to 0.42±0.08 % (non-*Hippophae* stand). The present study revealed that the *Hippophae* growing stand could enhance the soil nitrogen up to 0.29 % under natural condition. The maximum concentration (0.098±0.003 %) of phosphorous was found in the soil of *Hippophae* stand, which was comparatively higher, than the values (0.06±0.002 %) obtained for non-*Hippophae* stand. The fact is also proved by the present study where the amount of potassium in the soil of *Hippophae* stand was found lower than the non-*Hippophae* stand due to the presence of organic matter added by *Hippophae* biomass of both above and below ground. The higher concentration of calcium (Ca) was obtained in the soil of *Hippophae* stand (0.19±0.01 %) than the non-

Hippophae stand ($0.11 \pm 0.01\%$). The overall results of the present study indicated that the *Hippophae rhamnoides* (Seabuckthorn) plays a significant role in improving soil and its potential can be harnessed for reclamation and restoration of higher Himalayan landscapes.

**РОЛЬ ОБЛЕПИХИ
В УЛУЧШЕНИИ ПОЧВЕННОГО ПЛОДОРОДИЯ
В ЦЕНТРАЛЬНЫХ ГИМАЛАЯХ, ИНДИЯ**

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Индия

В работе представлены результаты исследований влияния облепиховых насаждений на содержание элементов минерального питания в почве, ее pH и влагообеспеченность в условиях Гималаев (Индия). Показана существенная роль облепихи в улучшении большинства показателей.

**CURRENT SITUATION OF THE SEABUCKTHORN
IN BOLIVIA**

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The most representative cultivate of the Seabuckthorn (*Hippophae rhamnoides* L.) in Bolivia is located in the Municipality of Santiago de Callapa of the Pacajes Province in the La Paz Department ($17^{\circ}28'45''$ S, $68^{\circ}21'19''$ W), municipality with 100% of Basic

Unsatisfied Needs of poverty to 3800 m.a.s.l. The extreme temperatures oscillate between -15°C in winter to +20 °C in summer. There are 70 hectares of Seabuckthorn (*Hippophae rhamnoides* ssp. *sinensis*) cultivated in 2003 with the following characteristics: The soils of this zone are silty soil chalky soil and sandy soil with low content of organic material and poor drainage due to erosion. The 90% of the plants survived until 2004, up to now the percentage of survival of the plants are 55% due to the variability of the soils. The first registered fruits were the 2006 and at the present there are more than thousand plants that are in fructification period. The Seabuckthorn fructification in extreme conditions of climate and soils of the Santiago de Callapa municipality, demonstrates that in the near future the plant will be used as relief to the poverty and food safety to 2.2 million of Bolivian people that live in extreme rural poverty conditions in the high lands and valleys of Bolivia.

Other experimental cultivates were introduced in the La Paz, Oruro, Cochabamba, Tarija, Potosí and Santa Cruz Departments, that have different edaphologic and climatic conditions, therefore works of agronomic research and works of perspectives of Seabuckthorn industrialization were done in coordination with the universities of Bolivia.

As a consequence of these results, the Bolivian government has promulgated the Law Number 3819 that declares a national priority the execution of the project "Consolidation of the Seabuckthorn introduction in the arid and eroded zones of the high lands and valleys of Bolivia - The Second Phase"

Now the Bolivian government comes organizing the project execution in coordination with the People's Republic of China government, at the same time there will be needed the technical advice of experts to manage and consolidate the cultivate of the Seabuckthorn in Bolivia successfully.

Key words: Seabuckthorn, cultivate, climate, soils, survival, fructification, extreme rural poverty, consolidation.

СОВРЕМЕННОЕ СОСТОЯНИЕ РАБОТ ПО ОБЛЕПИХИ В БОЛИВИИ

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Боливия

Проанализированы результаты первых закладок облепихи в Боливии. Показана исключительно высокая значимость развития облепиховодства в стране, в связи с высоким уровнем бедности. Рассмотрены государственные программы развития отрасли.

MODERN CONDITION OF STUDIED SEABUCKTHORN (*HIPPOPHAE RHAMNOIDES L.*) IN KYRGYZSTAN

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In Kyrgyzstan, the sea-buckthorn populations is growth in Issuk-Kul, Kochkor, Chyi, Talas, Suusamur, Ketmen-Tobo, At-Bashu and other valleys and high water beds. The main massif of sea-buckthorn populations is growth in Issuk-Kol basin. A total massif area in northern and eastern part of coast is 5700 ha including with biological supply above 2000 ton. About forty (40) forms in the wild of brushwood of sea buckthorn in high water beds of Jergelan, Tup, Aksy were revealed by Malena. Comprehensive investigation carrying on biochemical studies (as wild and introducing sorts) as well as influences of biological active substances from Issuk-Kol fruits to

human health and animals. Sportsmen and astronaut have been participated in the program “Inter Space” where the adaptogene were received.

In spite of comprehensive investigations of sea buckthorn distributions in Kyrgyzstan the sea buckthorn is not enough studied. In recent scientific publication by Sarymsakov Z.X. “The sea buckthorn in south of Kyrgyzstan (2004) where author notice of phytocenosis of species, characteristics of main formation and association of sea buckthorn. In the book the bio-morphological characteristics of forty three (43) forms of local sea buckthorn populations are given. In the network of Regional Project “ UNEP GEF “In situ/on farm conservation and use of agro biodiversity (horticulture and their wild congener) in Central Asia since 2007 diversity of forms of sea buckthorn in Issuk-Kol and Naryn valleys were studied.

In this research we have been revealed ten (10) plus form distinguish low (one form of without strigose) availability of strigose, high crop productivity, relatively large fruited and high content of karatinoids.

At the moment the medical institutions and population requirements in the medicine preparations cover at the expense of import from boarder and it is relatively very expensive. By the way, the rich flora of Kyrgyzstan has origin of row product for many medicine preparations to refer the sea buckthorn.

In our republic the natural brushwood of sea buckthorn is only origin to receive the necessary row – fruits in the plan of bioresources where not enough studied. In case, that in the republic in the systems of forest sector for planting of sea buckthorn not developed yet.

Though, in the republic having enough resources (natural brushwood by country) and huge possibilities for industrial plantations may to organize collection, processing and output medicine and food productions. The first attempt involving of local community in order to organize small enterprises for collection, processing and output production by “Forest Product”, “Forest Sacrament” organizations were made.

In the republic scale of problem sustainable use and reproduction of plant rows in 2002 was organized association “Phytofarm” by project of “Encouragement of private economics” by German Technical Centre (GTZ), also “Biosphere Reserve of Issuk-Kol” and project “Sea buckthorn” in coastal zones of lake.

Achievement in this fields it dependent from public awareness, where local community can to organize and work on row collections, growing and processing.

Key words: cenosis of Seabuckthorn, medicinal preparations, Central Asia, Kyrgyzstan, form diversity, biochemical composition, juice and oil production, prospective forms, habitus, biologically active substances.

СОВРЕМЕННОЕ СОСТОЯНИЕ ИССЛЕДОВАНИЙ ПО ОБЛЕПИХЕ (*HIPPOPHAE RHAMNOIDES*) В КЫРГЫЗСТАНЕ

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В материале представлено современное состояние исследований по облепихе в Кыргызстане, а также раскрыт потенциал возможных путей расширения использования этой культуры в республике.

GENETIC RESOURCES OF *HIPPOPHAE* IN NORTH EASTERN INDIA AND ITS STATUS AND UTILIZATION

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The genetic resources of Hippophae in North East India that comprising of the Sikkim Himalaya and Eastern Himalayan regions is rich and not enumerated into fuller extent. Documenting the nature

of genetic variability and its magnitude among natural populations of Seabuckthorn is necessary to know its status in NE India. In this region seabuckthorn grows in dry temperate regions at an altitude of 2000-3100 m asl. In this paper various germplasm of seabuckthorns from this region has been described with morphological descriptors. The status of the wild population with reference to availability, distribution, cultivation and conservation has been worked out based on field verification. Three main species of Hippophae viz., *H. rhamnoides*, *H. tibetana* and *H. salicifolia* have been recorded from this region. Several morphotypes of these species have also been identified.

Key words: Arunachal, Eastern Himalayas, Hippophae, Sikkim, Seabuckthorn, NE India.

ГЕНЕТИЧЕСКИЕ РЕСУРСЫ ОБЛЕПИХИ В СЕВЕРО-ВОСТОЧНОЙ ИНДИИ, ЕЕ СТАТУС И ИСПОЛЬЗОВАНИЕ

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Исследованы генетические ресурсы облепихи на Северо-востоке Индии. Установлено, что основными видами в регионе являются *H.rhamnoides*, *H.tibetana* и *H. salicifolia*. Проведено их морфологическое описание, а также даны способы возделывания и сохранения популяций.

EXPLORING THE SEABUCKTHORN TRANSCRIPTOME FOR ABIOTIC STRESS TOLERANT ELEMENTS

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Seabuckthorn (*Hippophae rhamnoides* L.) plant has been of keen interest to plant researchers for harnessing its immense ecological and medicinal properties. Mainly, efforts have been made to study the basic biology of the plant, its geographical distribution and to develop improved seabuckthorn cultivars and products. However, there is practically no data on gene expression profiling in this important species. From biotechnology point of view, seabuckthorn genome is expected to harbor genomic elements that render it highly tolerant to abiotic stresses considering the fact that the plant is highly adaptable to varying and extreme environmental conditions with temperatures ranging from -43°C to 40°C , drought, high altitude, salinity and alkalinity. Keeping this in mind, our laboratory started a project to develop an EST (Expressed sequence tag) database for seabuckthorn. We have sequenced about 4500 clones from the cDNA library prepared from the leaf tissue and submitted 2787 high quality sequences (>100 bp in length) in the EST database (dbEST) of NCBI. Subsequently, these sequences were clustered with the help of CAP3 and a non-redundant unigene dataset was prepared. Of 1584 unigenes data set, nearly 50 unigenes showed very high similarity to known proteins that are involved in abiotic stress tolerance. These unigenes might represent robust alleles of already known genes in other plant species. Moreover, many unigenes did not showed any similarities to the known proteins and therefore we expect that some novel components (genes) involved in cold and drought response pathway might also exist in seabuckthorn which helps it to cope with such extreme temperatures. It would be interesting to study the putative function of these unigenes. In order to char-

acterize the unigenes in detail, analysis was done to identify protein domain in the predicted proteins from the unigene dataset. ESTs provide a robust sequence resource that can be exploited for gene discovery, genome annotation and comparative genomics. Therefore the EST data generated from seabuckthorn will help in understanding the abiotic stress management in plants.

ИЗУЧЕНИЕ ТРАНСКРИПТОМОВ СТРЕССОУСТОЙЧИВОСТИ ОБЛЕПИХИ

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Работа посвящена изучению геномного состава облепихи с точки зрения поиска генов устойчивости к стрессовым ситуациям. В этой связи запущен проект по разработке базы данных частей транскрибированных последовательностей ДНК (Expressed sequence tag) для облепихи. Найдены ранее не известные последовательности, отвечающие за устойчивость к засухе и низким температурам.

SEABUCKTHORN (*HIPPOPHAE RHAMNOIDES L.*) IN ZARAFSHAN NATURE RESERVE

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The Zarafshan Nature Reserve has an area more than 2,3 thousand hectare and is located 15 kilometers southeast of Samarqand (Uzbekistan) on the right bank of the Zarafshan river. The reserve was established in 1975. One of the main purposes of its establishment is preservation of the Tugai-forest in the floodlands of the

Zarafshan river, and the protection of valuable native fruits and medicinal plants growing in the area. From about 300 species of plants 59 one medicinal are recorded in the reserve's territory. Among them are fruit species such as *Elaeagnus angustifolia* L., *E. orientalis* L., *Berberis integerrima*, *Crataegus turkestanica*, *Rosa canina* L., *Juglans regia* L. One of the most valuable of the useful plants growing in the reserve is certainly the seabuckthorn (*H. rhamnoides* L.). The fruits of sea-buckthorn are widely used in the food-processing industry and in daily life. Sea-buckthorn fruit is rich in several important vitamins, vets etc, such as: glycerides of oleic, linoleic, palmitic and stearic acids, phytoncids carotene and carotenoids 110 mg/100 g and vitamin E 110 mg/100 g. The red-orange form is more than other forms rich in oil/liquid with a characteristic taste and smell. Its vitamin content is much higher than in any other cultivated fruit or vegetable. Pulp and seeds contain oils which are carriers of many concentrated bio-active substances.

Seabuckthorn is a multi-purpose shrub with yellow-orange-reddish berries belonging to the family of *Elaeagnaceae*. Its is highly adaptable to varying and extreme conditions, including temperatures ranging from -43°C to +40°C, drought, high altitudes ranging from 600-5000 m above sea-level, salinity, alkalinity, and inundation.

In the early 1980's the genetic resources of sea-buckthorn in the Zarafshan river valley, in particular in the territory of the nature reserve, were investigated. For the last 30-40 years the intensive agricultural activities in the area have resulted into destruction of the Tugai-vegetation, sea-buckthorn in particular. This occurred after long-lasting unsustainable use of wild populations, cutting down trees for timber unregulated grazing and absence of protection and forest restoration measures. Nowadays only in the unique Zarafshan Nature Reserve, sea-buckthorn thickets are being conserved. The continuous degradation of the Tugai-vegetation is yet still affecting the unique genetic diversity of the sea-buckthorn growing in the Zarafshan river valley. Plant diversity and some biological features such as water requirements, reproduction biology and age changes were studied. A large variation in colour, shape and size in sea-buckthorn fruits were observed to be found.

The research's carried out beginning from the 2000 year in the Zarafshan Nature Reserve showed that the ecology of the sea-

buckthorn had changed considerable in comparison with 1980. Ongoing researches showed however that despite the heavy human disturbance, a large diversity in sea-buckthorn forms can be still found in this area.

The unique features of the plant, especially its combination of environmental and rural development characteristics with nutritional and medical applications, have contributed to the substantial interest and recognition it has received internationally from researchers and development practitioners.

Sea-buckthorn has very valuable applications, which are largely unknown and not fully used in Uzbekistan at the moment. These properties make sea-buckthorn an ideal candidate for soil and water conservation in extreme and marginal areas, besides its considerable economic potential.

To prevent further erosion of sea-buckthorn diversity, further research is needed. As the sea-buckthorn is a valuable, but underutilized medicinal fruit species, under heavy human pressure, it is necessary to develop a strategy for promoting its conservation and sustainable use.

The sustainable conservation and use of the sea-buckthorn is a very strategic contribution towards the maintenance of the tugai-forest and water-systems in addition of being an interesting source of income generation for local populations.

ОБЛЕПИХА (*HIPPOPHAE RHAMNOIDES L.*) В ЗЕРАВШАНСКОМ ПРИРОДНОМ ЗАПОВЕДНИКЕ

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Показана роль и значение облепихи в природном комплексе Заравшанского заповедника (Узбекистан). Акцентированы проблемы сохранности насаждений, в том числе и облепиховых зарослей в долине реки Заравшан, установлены значительные изменения в экологии культуры в связи с активной сельскохозяйственной деятельностью в регионе.

SEA BUCKTHORN IN BACK OF BAIKAL

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Sea buckthorn is the leading industrial crop in Transbaikalia, the vitamins complex, complex of biologically active substances and essential therapeutic agent – sea buckthorn oil are contained in its fruit.

Whereas the demand for sea buckthorn is growing up, the establishment of intensive plantation is to be the principal direction in creation the raw material base with significant importance of intensive varieties usage.

In natural sea buckthorn in Buryatia more than 200 diverse forms are selected and examined, they give the opportunity to breeders to create new heavy-productive varieties with different features combination.

One of the tasks for breeders was breeding of winter-hardy varieties well adapted to local soil and climatic parameter, with compact unbarbed crowns, productivity 7-10 tons per hectare and high in biologically active substances in fruit.

In 1985 for the first time Buryat varieties of sea buckthorn: Atsula, Ayaganga, Stepnaya were accepted for State variety examination and in 1988 they were released in Buryatia.

Beginning from 80-s Tunka forms of sea buckthorn were drawn to crossbreeding, breeding of masculine Tunka and Altay varieties gave perspective hybrid, in 1988 first indeterminate unbarbed variety Sayana was sent to State Variety Test duration.

During 30 years of research 14 buryat varieties of sea buckthorn were created, most of them are of Sayansk origin, indeterminate, sweet-fruited, and high in biologically active substances.

In fruit of Atsula sea buckthorn variety the oil content is 7, 9%, Sayana, Naran, in memoriam of Zakharova are sweet-fruited varieties with sugar content up to 9%.

Patent of State Commission of Russian Federation were received for 5 varieties.

The best propagation method for sea buckthorn in Buryatia is considered to be propagation by herbaceous cutting in plastic foil houses. Striking of roots depending on the variety varies from 61, 1 % (Sayana) to 84, 2 % (Sokratovskaya). Total cutting drafting content for past years is 100,000.

Roots' striking of hardwood cutting using black nap as mulch material is 80%.

The studying of cultivation technologies of indeterminate sea buckthorn is topical now because the questions of preparation of the soil, content of the soil, spacing, amendment, watering of determinant varieties of sea buckthorn have been studied already.

At present time the research of effective spacing for indeterminate varieties of sea buckthorn Bayangol and Zakharovskaya with landing pattern 4x1,5 m; 4x1,0 m; 4x0,7m there was no appreciable difference in the length of shoots and thickening of the boles, but comparing the results for 1 hectare hi-pop planting is more advantageous.

Average amount of increase for Bayangol in 2008 in hi-pop planting overshoot the norm on 26-43%, for Zakharovskaya – 20-37%.

Key words: Sea buckthorn, softwood cutting, spacing, shoots increase.

ОБЛЕПИХА В ЗАБАЙКАЛЬЕ

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Представлены результаты селекционной работы по облепихе в Бурятии. Обозначены ключевые направления и селекционные задачи. Описаны используемые в регионе технологии возделывания и размножения культуры.

SEABUCKTHORN INTRODUCTION IN BELARUS

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At the territory of Belarus seabuckthorn does not occur in wild state. The first plants appeared at the Central Botanic Garden of the National Academy of Sciences of Belarus in 1930's. Studies of them have been started at the same time. It was conducted the study of first Russian varieties, methods of their propagation in the conditions of the Republic of Belarus were elaborated.

The first seabuckthorn collection at the Institute for Fruit Growing has being created in 1980's. As a result of the study on basic characters including yield, average fruit weight, fruits chemical composition of 19 varieties such as 'Botanicheskaya', 'Vorob'yovskaya', 'Vitamnaya', 'Dar Katuni', 'Zolotistaya', 'Maslichnaya' 'Novost Altaya', 'Nivelena', 'Obilnaya', 'Oranzhevaya', 'Otradnaya', 'Podarok sadu', 'Prevoshodnaya', 'Samorodok', 'Shcherbinka-1', 'Shcherbinka-6', 'Trophimovskaya', 'Chuiskaya' and 'Yantarnaya' and of 2 hybrids K-24 and IV-56, the availability of cultivating in the conditions of Belarus of the varieties created in the Botanic Gardens of MSU and an insufficient winter hardiness of the studied varieties of the selection of the Scientific Research Institute of Horticulture of Siberia were revealed. Based on these results there were passed to the State Variety Trial the following varieties: 'Botanicheskaya', 'Podarok sadu', 'Trophimovskaya' and 'Nivelena' catalogued later into the State Register.

In 1992-2006 a complex evaluation of 23 varieties ('Botanicheskaya', 'Botanicheskaya luchistaya', 'Dorana' 'Finskaya', 'Grodnenskaya', 'Hodnevsкая', 'Inya', 'Kaliningradskaya', 'Krasnoplodnaya', 'Lomonosovskaya', 'Mariya', 'Mendelevskaya', 'Nivelena', 'Otradnaya', 'Pantelevskaya', 'Podarok sadu', 'Prevoshodnaya', 'Priokskaya', 'Trophimovskaya', 'Vorob'yovskaya', 'Yolochka' 'Zhyoltaya Rannyaya', 'Zolotoy Shar'), , and 7 promising hybrids created by V.A. Phepelov (Nizhnij Novgorod, Russia) which are 10-86, 4-87, 20-88, 29-88 ('Plamennaya'), 5-87 (male), 6-87 (male), 7-87 (male) was carried out. The variety 'Plamennaya', characterized

by high productivity (17 t/ha at planting scheme 4x2 m), large fruit (0.8 g), and valuable chemical composition of fruits was passed to the State Variety Trial and catalogued into the State Register (2007).

The sources of high winter hardiness and productivity, large fruits, fruit quality, dry and easy coming off fruits were selected and were used for breeding.

It was estimated a study necessity of varieties with high resistance to wilt and high sugar and ascorbic acid content in Belarus condition.

Key words: Belarus, introduction, seabuckthorn, varieties

ИНТРОДУКЦИЯ ОБЛЕПИХИ В БЕЛОРУССИИ

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Обсуждаются результаты интродукции инорайонных сортов облепихи в Белоруссии. Изучены основные хозяйственно-биологические признаки, а также представлена биохимическая характеристика исследуемых сортов. Рекомендованы лучшие формы для дальнейшей селекции.

SELECTION POTENTIAL OF WINTER RESISTANCE IN SEABUCKTHORN

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There were studied 137 seabuckthorn varieties of different genetic origin and estimated their winter resistance by the method of artificial freezing.

The experiments testify that the tissues of annual seabuckthorn shoots have higher frost resistance than flower buds. Such regularity is characteristic for both female and male plants.

First component of winter resistance is not limiting for seabuckthorn under the conditions of Middle Russia. Frost resistance of studied varieties and hybrids in the beginning of winter was sufficient to preserve vitality and productivity of plants. Hardened, in the middle of December they endured a temperature of -25°C without visible damages.

The level of resistance to maximal frosts in the most of studied varieties is sufficient to keep vitality and productivity. In the middle of winter, hardened samples withstand a temperature of -40°C .

The conditions of III and IV components of winter resistance are critical for seabuckthorn. There are few of studied varieties that are able to keep frost tolerance (to -25°C) during thaws in the middle of winter and even less quantity of them possesses high tolerance of buds and tissues to returning frosts (-35°C) after thaws at the end of winter.

By the method of modelled winter damaging factors it was selected varieties perspective for selection:

➤ for the high potential frost resistance in hardened condition and complex of valuable economic indexes – 'Botanicheskaya', 'Kudrina', 'Nadezhda', 7/89, 30/89 ♂, 31/89 ♂, 26/90, 37/90, 48/90, 19/91, 22/91, 28/91, 5/93 ♂, 6/94;

➤ for the ability to preserve high frost resistance during thaws – 'Botanicheskaya', 'Dar Kazakovu', 'Dyuimovochka', 'Zarevo', 'Otradnaya', 'Podarok Sada', T-30 (Bot. garden of Moscow State Univ.), T-50 (Bot. garden of Moscow State Univ.), s. Maslichnoi №8, 16/88, 7/89, 19/89, 23/89, 26/90, 35/90, 42/90, 48/90, 26/91;

➤ for the ability to recover frost resistance in the process of repeating hardening after thaws – 'Botanicheskaya', 'Gomelskaya', 'Nadezhda', 'Plamennaya', T-30, 30/89 ♂, 25/90, 39/90, 48/90, 51/90, 8/91, 16/91, 4/93, 7/93;

➤ for high resistance to all components – 'Botanicheskaya', T-30, 48/90.

Certain amount of seedlings inherit the high level of the components of winter resistance without "dilution" over generations. In some combinations there appeared transgressive genotypes that exceed parent forms in resistance.

ГЕНЕТИЧЕСКИЙ ПОТЕНЦИАЛ ЗИМОСТОЙКОСТИ ОБЛЕПИХИ

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Проведена оценка зимостойкости сортообразцов облепихи различного генетического происхождения методом искусственного промораживания. Эксперименты свидетельствуют, что ткани однолетних побегов облепихи имеют более высокую зимостойкость, чем цветочные почки. У большинства исследуемых сортов уровень устойчивости к критично низким температурам достаточно высок для поддержания жизнеспособности и продуктивности. Предложены перспективные комбинации скрещивания по разным элементам зимостойкости. Выявлены генотипы, превышающие уровень зимостойкости родительских форм.

GENETIC AND SELECTIVE ESTIMATION OF HYBRID SEA BUCKTHORN SEEDLINGS BY FRUIT COLOUR

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Seedlings of twelve combinations that obtained by crossing of varieties of different ecological and geographical origin were analyzed for genetic segregation in fruit colour. In the experiment there were presented fruit bearing varieties with fixed fruit colour. Heredity of pollinators could most confidently be conjectured through their origin.

Forms with orange (of different tints) fruit colour prevailed amongst hybrid seedlings of the most of crossing pairs; amount of them reached 61-94% depending on combination. Almost in every combination regardless of parent forms seedlings with yellow and red fruits appeared. Seedling with yellow fruits predominated only in intrapopulational combination Kitoyskaya 14 x Kitoyskaya 8 (66%), where there were no red fruit forms. It's worthy to note that cultivated Kitoyskaya population is presented by forms with yellow and yellow-orange fruits.

Combinations of Gomelskaya x s. K-24 (radiomutant) (39%), T-50 x s. K-24 (radiomutant) (38%) and Karatal 8 x s. K-24 (radiomutant) (25%) have significant amount of red fruit forms. In these pairs, mother forms have intensively coloured fruits. Based on quantity of red fruit hybrids in these families, given character is also inheritable in the form-pollinator. High percent of red fruit seedlings in other combinations with male form s. K-24 (radiomutant) can serve as confirmation of this. Orange fruit plants having combined with the pollinator gave an outcome of red fruit seedlings: in combination of Botanicheskaya x s. K-24 (radiomutant) – 13%, of Karatal 22 x s. K-24 (radiomutant) – 14%.

The analysis of topcrosses showed significant effect of maternal ($F=8.84$, $F_{01}=6.76$) and paternal ($F=5.62$, $F_{05}=3.89$) forms on “fruit colour” index appearance in progeny.

From above-mentioned combinations we selected cultivars and elite forms of seabuckthorn with high content of carotenoids: 'Zarevo' (carotenoids content is up to 259 ppm), 'Nadezhda' (to 316 ppm), 'Nizhegorodskii Suvenir' (to 284 ppm), 'Plamennaya' (to 224 ppm), 'Ryabinka' (to 333 ppm), elite forms 35/90 (to 257 ppm), 46/90 (to 302 ppm), 51-84-10 (to 452 ppm), 51-84-73 (to 279 ppm).

So, there were studied initial forms that could be donors of red fruits in selection. They are 'Gomelskaya', 'Otradnaya', T-50 (selection of Bot. garden of Moscow State Univ.), Karatal 8 and a male form s. K-24 (radiomutant). Great outcome of seedlings with red fruits is noticed in combinations of Botanicheskaya x s. K-24 (radiomutant) and of Karatal 22 x s. K-24 (radiomutant).

ГЕНЕТИКО-СЕЛЕКЦИОННАЯ ОЦЕНКА ГИБРИДОВ ОБЛЕПИХИ ПО ОКРАСКИ ПЛОДА

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Поведена оценка окраски плодов у гибридов облепихи от скрещивания различных экологических форм. Проведен гибридологический анализ потомства. Установлено, что доминирующей окраской является оранжевая. Найдены комбинации, дающие в потомстве формы с желтыми плодами. Предложены также более ценные с технологической точки зрения доноры красноплодности.

CHARACTERISTICS OF SEA BUCKTHORN WILT RESISTANCE

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Versatile investigations of seabuckthorn wilt resistance have been conducted. Selected wilt resistant forms (F_1) of the Katun population are heterogeneous in producing wilt resistant progeny (F_2). Losses of seed progeny (from free pollination) of various forms made from 27 to 67% of plants. The peak of seedling death falls on the 4-6th year after planting. There are no revealed differences in the wilt resistance between male and female individuals.

Hybrid seedlings of different combinations are represented in another experiment. In a year after planting on the permanent place

(3rd year of life) considerable losses of wilt infected plants began to happen, independently on parent forms origin. Death peak fell on 5th year of plant life (29%). Then in 6-7th year, the quantity of dying plants gradually decreased. In 8th year (6th year on the permanent place) there was sharp reduction of hybrid seedlings death when only 1% of plants had died.

Observations and assessments over clonal progeny of 13 seabuckthorn varieties originated from Siberia showed considerable differences in wilt resistance within it. The cultivars of 'Novost Altaya', 'Maslichnaya', 'Prevoshodnaya' were high field wilt resistant. The quantity of wilt died plants in these cultivars didn't exceed 10% for the 6-year period. The most of the cultivars present in the experiment were of medium resistance or susceptible to mycotic drying. The most susceptible was a cultivar of NNSAA selection 'Priokskaya', which had got 64% of died saplings. It should be noted that the given cultivar have been selected from the Novost Altaya x Sayanskaya 40 family. Totally, for the 6-year period 27% of saplings died as a result of mycotic drying. A peculiarity in this experiment was that there was no clear dependence between the age of plants and their elimination. Such dependence was characteristic for seabuckthorn seedlings.

A selective estimation of hybrid progeny for mycotic drying resistance showed no direct influence of the parents wilt resistance on the quantity of resistant hybrid seedlings. Susceptible 'Vitaminaya' cultivar having been crossed with tolerant Sayanskaya 40 gave 61.5% of wilt resistant progeny. Similar results were obtained in Karatal 8 x s. K-24 (radiomutant) family (Middle Resistant /MR/ x Resistant /R/) – 62.0%. At the same time in one of the MR x R schemes (Karatal 8 x Sayanskaya 40) the outcome of the seedlings without infection made only 27.1%.

Series of crossings between varieties of different genetic origin allowed revealing a number of the most valuable combinations. These are Botanicheskaya x s. K-24 (radiomutant), Botanicheskaya x Sayanskaya 40, Novost Altaya x Katun ecoform, Karatal 22 x s. K-24 (radiomutant), Otrdnaya x 7/87, T-50 x s. K-24 (radiomutant). A part of wilt resistant seedlings in them made 76.6-88.6%. Among hybrid progeny of those families there were selected varieties and the forms perspective for further selection which possess both high field resistance to mycotic drying and other valuable indexes.

ОЦЕНКА ОБЛЕПИХИ ПО УСТОЙЧИВОСТИ К УСЫХАНИЮ

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Проведена оценка гибридного фонда облепихи различного происхождения по устойчивости к усыханию. Установлены существенные различия по этому показателю между сортами. Выявлены критические периоды развития заболевания. Предложены перспективные комбинации скрещивания в направлении повышения устойчивости потомства.

FINDINGS ON SELECTION OF SEA BUCKTHORN POLLINATORS

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From practice, the economical and biological features of pollinators significantly exert influence on the yield of seabuckthorn plantations. The most important feature that characterizes pollinators is undoubtedly pollen-production. That feature depends in many cases on the plant tolerance to diseases (wilt resistance) and to the abiotic factors of the environment (winter resistance). Another but all the same important feature is the quality of pollination that depends on plant height (the radius of pollen spread) and florescence duration.

Taking into account those indexes we've been carrying out investigations and selection of seabuckthorn pollinators since 1982. There studied the morphological and biological features of male plants, the inheritance regularity of some characters. Certain perspective pollinators were selected as well as an initial material for further selection.

The analysis of hybrid progeny revealed some peculiarities and regularities in morphological features inheriting. Hybrids between Baltic and Sayan ecoforms had got segregation in morphological characters. The degree of inheritance in Baltic genotype is significantly higher than in Sayan. Evidently the most part of the hereditary information in the latter is recessive.

The degree of inheritance in Katun seabuckthorn is clearly higher. Forms of the Baltic x Katun group had more thick and thorny branches and dense layer of trichomes versus forms obtained using Sayan seabuckthorn. High plants prevail amongst the hybrids of the group while in Baltic x Sayan combinations most of plants are of moderate growth.

Hybrids from radiomutant seedlings of the Katunskaya 24 cultivar greatly vary on morphological features. There are samples of moderate as well as of high growth amongst them. Rather low prickliness is noticed in these samples comparing with the other combinations.

Winter resistance studying during many years is not revealed primary influence of mother or father morphs on how low temperature tolerance of buds and tissues forms in progeny. That testifies to the polygenic type of inheritance.

There selected some perspective pollinators, two of them undergo State quality testing (Debut and Gerakl cultivars).

Keyword: Selection, pollinator, inheritance, combination, pollen-production, winter resistance.

СЕЛЕКЦИЯ ОПЫЛИТЕЛЕЙ ОБЛЕПИХИ

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Изучены морфологические и биологические особенности мужских сортообразцов облепихи, а также закономерности наследования ряда важных признаков. Обсуждается степень на-

следования признаков различных экологических форм облепихи. Отобраны и переданы на Госсортоиспытание два перспективных опылителя.

SEABUCKTHORN COLLECTION OF THE LISAVENKO INSTITUTE AND ITS POTENTIAL FOR FURTHER SELECTION

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It seems to be that at Lisavenko Institute (Barnaul, Russia) one of the world's biggest sea-buckthorn collection is located where more than 50 000 seedlings are under evaluation.

The most common subspecies for Western and Eastern Siberia where the Lisavenko Institute carrying out its activity is *Hippophae rhamnoides ssp. mongolica*. There are a lot of ecotypes from different regions of Siberia were include in selection within this subspecies. As a result a huge collection of varieties have been selected with certain potentials for further selection.

Undoubtedly, each of well known subspecies of *Hippophae rhamnoides L.* is distinguished with one's typical features, which however become apparent only under certain conditions. The present paper describes the results of comprehensive analysis of sea-buckthorn genetic collection of the Lisavenko Institute carried out by numerous group of authors. Most promising directions for selection are proposed as well as valuable recent cultivars are defined. More than 700 breeding cultivars (years of hybridization are from 1961 to 1995), and 650 selected varieties from 140 hybridization alternates (years of hybridization are from 1996 to 2003) have been studied.

It have been found that analyzing material is high promising for such valuable breeding directions as follow: large berry size, palatability, early ripening, thornlessness. Mentioned collection is also interesting in selection for high carotenoids content, easy berry picking up as well as for moderate growth vigour.

Keywords: sea-buckthorn collection, selection features, new cultivars.

**КОЛЛЕКЦИЯ СОРТООБРАЗЦОВ ОБЛЕПИХИ
НИИСС ИМЕНИ М.А. ЛИСАВЕНКО,
ЕЕ ПОТЕНЦИАЛ ДЛЯ СЕЛЕКЦИИ**

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Проведена комплексная оценка генетического материала облепихи селекции НИИСС имени М.А. Лисавенко. На основе генетического анализа выделены доноры ценных хозяйственно-биологических признаков и установлены основные перспективные направления дальнейшей селекционной работы.

**ASSOCIATION FACTORS
OF SEA-BUCKTHORN CHARACTERS**

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Phenotype regularities of correlative variability of quantitative sea-buckthorn (*Hippophae rhamnoides*) characters do not able to answer a question: Is it possible to use such regularities in sea-

buckthorn breeding and cultivation? The solution of this question is in evaluation of associations those are due to different variability factors, namely hereditary (genetic) and environmental one.

Hereditary factor may appear by:

1. Separate gene pleyotropy
2. Location of several genes in one linkage group
3. Effect of natural or man-made selection.

Environmental factor associates characters by metabolic coordination of final character formation as a result of external influences.

Earlier we managed to evaluate genetic and environmental correlation links of fruit characters set: fruit weight, total dry substances, total sugars, total acidity, ascorbic acid, fruit oil and total carotenes by application of linear correction approach.

For more detailed evaluation of biological causes of association we were subjected a set of genetic and ecological correlation matrixes obtained to factor analysis based on independent factors model.

Three hereditary factors explain about 50% of total genetic variation.

H-I Factor. It was named as “Fruit quality”. A structure of it shows that it is loading with both total dry substances contents and total lipids. We suggest it as a result of sea-buckthorn selection directed on oil contents.

H-II Factor. It was named as “Fruit taste”. A structure of it shows that it is loading presumably with total sugars contents. This factor may appear as a result of sea-buckthorn selection on fruit taste.

H-III Factor. It was named as “Fruit size”. It is loading presumably with fruit weight. It may be interpreted by sea-buckthorn selection on fruit size.

Thus the hereditary association of sea-buckthorn characters may be interpreted presumably as a result of natural or man-made selection.

Four ecological factors explain about 70% of total ecological variation.

E-I Factor. It was named as “Water limitation”. Opposite interaction of its principal characters (total dry substances and oil contents) here indicates that water access into sea-buckthorn plants is limited.

E-II Factor. It was named as “Photosynthesis”. The total sugars content is the main character loading it. This factor determines by insolation features.

E-III Factor. It was named as “Shade effect”. A structure of it represents total organic acids and oil contents are to be in opposite state. It seems to be formed by insolation peculiarities within sea-buckthorn plant crown.

E-IV Factor. It was named as “Chromoplasts”. It is loading mainly by total carotenes. It is determined by total number of coloured plastids of mature gerontoplasts. The quantity of them is under phytohormonal control during maturation process.

Thus the most of ecological association of sea-buckthorn characters may be interpreted as the effect of two limiting environmental factors: water availability and insolation level.

Key words: sea-buckthorn, fruit composition, correlative variability, factor analysis, heredity, environmental factors.

АНАЛИЗ КОРРЕЛЯЦИОННЫХ ЗАВИСИМОСТЕЙ НА ОБЛЕПИХЕ

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Фенотипические проявления корреляционной изменчивости количественных признаков облепихи не позволяют использовать такие закономерности в селекции и возделывании облепихи. Решение этого вопроса заключается в оценке сопряжения, обусловленного различными факторами изменчивости, а именно, генетическими и экологическими.

В статье дается анализ сопряженной изменчивости количественных признаков облепихи, который показал, что ее структуру можно интерпретировать эффектом 2-х лимитирующих средовых факторов: уровнем влагообеспеченности растений и уровнем освещенности.

**TRIUMF – A SEA BUCKTHORN VARIETY
WITH REMARKABLE TRANSPORTABILITY
AND KEEPING CAPACITY OF FRUITS**

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The variety was isolated according their valuable characteristics from F₁ seedlings obtained from crossing of selected forms.

Plants are of medium height with weakly branched crown. Fruits are large (0,7-0,8 g) having elongated cylindrical form of bright-red color with thick, very strong peel. Pedicle is long (5-8 mm), strongly held at the base of fruit. The force of tearing off is 140 g, the force of squashing – more than 500 g.

Chemical composition of fruits: sucrose – 3,5%, organic acids – 1,5%, vitamin C – 93 mg%, carotene – 3,4, mg%, oil – 4,3%.

The variety has a universal use. Owing to high carotene content in fruits the excellent brightly-colored oil may be extracted from them.

The variety is late-ripening (second half of September) but fruits are preserved on plants till winter frosts.

The main merit of the variety is a very strong peel of fruit ensuring the “dry” tearing with pedicle, good safety during transportation and storage without freezing during 2 weeks or more.

The yield of variety is high: more than 11 kg from one plant in 6-year age.

The variety is resistant to endomycosis, drying up; it is not damaged with a sea-buckthorn fly.

The variety is registered in the State List of protected breeding achievements of Russian federation, 17, April, 2006.

The author of the variety is Shchapov N.S., authority certificate № 42999, patent № 3089.

Key world: Triumph, variety, dry tearing, transportability

ТРИУМФ – СОРТ ОБЛЕПИХИ С ВЫДАЮЩЕЙСЯ ТРАНСПОРТАБЕЛЬНОСТЬЮ И ВЫСОКОЙ СОХРАННОСТЬЮ ПЛОДОВ

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Представлен новый сорт облепихи Триумф, отличающийся рядом уникальных характеристик, таких как высокий уровень транспортабельности, продолжительной сохранностью плодов на ветвях, а также длительной лежкостью плодов.

VARIETIES OF SEA BUCKTHORN FOR INDUSTRIAL AND INDIVIDUAL GARDENING

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Varieties of sea buckthorn were originated (arisen, made) in institute of cytology and genetics SD RAS in association with Novosibirsk zonal fruit and berry experimental station. These varieties have different periods of maturing; early, middle and late. The purpose of varieties is food, technical and universal.

Varieties were obtained as a results of choice the parents and selection of the first generation (F₁). Important advantages of most varieties are large fruits and few thorns or their full absence.

1. Siberian Rumyanets is ultra early-ripening variety (berries mature in the middle of August). Variety is of universal purpose. Fruits have high carotene content and brightly red color. Remarkable brightly colored juice may is obtained from these berries.

2. Druzhina is early-ripening variety (picking maturity comes after 20 August). The variety may be mechanically harvested, it has low height, straight non-fragile shoots (sprouts), large fruits with the light dry tearing.

3. Kapriz is early-ripening variety for dessert purpose. Fruits have a high sugar content (up to 10%) and the pleasing aroma.

4. Podruga is mid-ripening variety having very large fruits (0,9-1,1g) with the sour-sweet taste.

5. Gold cascade is mid-ripening variety for food use having annual high yield. It has large sour-sweet fruits.

6. Parad is mid-ripening, universal, high-yield and winterhardy variety.

7. Zarnitsa is variety with late-ripening for technical use. Fruits are strong, orange-red with high content of carotene (28,8 mg%) and oil (4,53%), suitable for transportation.

8. Red Fakel is late-ripening variety for a technical use. It has strong fruits with high content of carotene and oil. Fruits are well retained on plants until winter frost and might be harvested by banging.

Originated varieties might be used in the future for breeding as donors of valuable traits.

Key world: variety, mechanical harvest, banging

СОРТА ОБЛЕПИХИ ДЛЯ ПРОМЫШЛЕННОГО И ЛЮБИТЕЛЬСКОГО САДОВОДСТВА

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Приведено краткое описание сортов облепихи совместной селекции Института цитологии и генетики СО РАН и Новосибирской зональной плодово-ягодной опытной станции.

NEW SEA-BUCKTHORN VARIETIES FOR MINUSINSK (RUSSIA) AREA

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At the beginning of the 20-th century a well-known naturalist I.P. Bedro first began to cultivate sea-buckthorn in Minusinsk. He has studied biology and peculiarities of growing of tuvinskaya population of the crop. Further, the work has been continued by U.G. Leonova. The first varieties Skorospelka and Kukuruzka were selected from the seedlings of Baikal ecotype, but not widely spread because of thorns and small fruits.

Since the 70-th years of the last century trials of the best specimens of Siberian breeding and the varieties of the European part of Russia are being carried out at the station. In economic-biological properties the varieties of M.A. Lisavenko RIHS breeding, such as Obilnaya, Prevoskhodnaya, Chyuiskaya, pollinator Aley are included into distributed (divided into districts) assortment of the southern area of Krasnoyarskiy region. The given varieties are highly winter-resistant, yielding, with large fruits, but subjected to mycosis fading and injured by sea-buckthorn fly.

Jointly with the scientists of M.A. Lisavenko RIHS, breeding work on the development of new native large-fruited varieties, adaptive to extreme conditions of the region, is being carried out at the station now. The varieties should be highly yielding, resistant to the main pests and diseases, with easy dry tearing-off fruits and different terms of ripening, available for processing and fresh consumption, without thorns and with compact crown.

When studying sea-buckthorn variety – fund of different ecological-geographical origin, the following sources have been selected: the varieties with weak thorns of shoots and high yield – Novost Altaya, Dar Katuni, Obilnaya, Prevoskhodnaya, Samorodok, Chuiskaya, Panteleevskaya; the varieties with large fruits – Chuiskaya, Velikan, Panteleevskaya, 73-02-37, 73-04-15; resistant to fading – Novost Altaya, Velikan, Otradnaya, Perchik, P-2, P-4, Podarok sada, Atsula, Sayana, Ayaganga, Podarok Nechernozemyu; resistant to sea-buckthorn fly – Velikan, buryat forms of late ripening.

Methods of remote interspecific hybridization with the application of geographically and ecologically remote pairs as well as analytical breeding are used. Besides, studying and selection of a valuable material in natural brushwood is carried out, the source of which are the first altaiskaya varieties, spread with the help of birds. New selected forms, developed in conditions of natural biocenosis, are the most resistant ones to the action of biotic and abiotic stress. Plants are bushes with the height of 1.0-2.2 m, with compact crown, thornless or a little thorny, the mass of a fruit is 0.6-0.9 g, from light-orange up to the red colour, the yield from a bush – 5-12 kg.

As a result of a complex breeding work, the varieties of new generation Minusa and Solnechnaya have been developed, which are included into State register in the Eastern-Siberian region.

Due to high adaptive qualities, sea-buckthorn occupied the leading role as a valuable horticultural crop in the south of Middle Siberia. At the years of studying small injuries of plants by frosts were observed, even at absolute minimum air temperature – 44.6⁰C. Sea-buckthorn is a highly-yielding crop. The yield reaches the value up to 25 t/ha not only on irrigated soils, but on turfed non-irrigated plots as well, at maximum air temperature in summer up to +38⁰C and low air humidity.

Key words: sea-buckthorn, breeding, selection, varieties, yielding, resistant, thorns, biocenosis.

НОВЫЕ СОРТА ОБЛЕПИХИ НА МИНУСИНСКОЙ СТАНЦИИ САДОВОДСТВА

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Приведены результаты сортоизучения облепихи различного происхождения в условиях Красноярского края, а также достижения собственной селекции, проводимой на основе отдаленной межвидовой гибридизации. Предложены генетические источники ценных хозяйственно-биологических признаков.

THE UTILIZATION OF SEABUCKTORN AT THE CONSOLIDATION, IMPROVEMENT AND CAPITALIZATION OF DEGRADED LANDS FROM ROMANIA

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The seabuckthorn (*Hippophae rhamnoides L.*), because of its ecological qualities, was one of species most used in the afforestation of excessively degraded lands from Romania, for which was called "salve of degraded lands" (Haralamb, 1969). It was used for afforestation in nearly all categories of degraded lands, especially those with very advanced degradation such as: land to excessively strong eroded, the gradients of ravine, highly fragmented land slides, alluvial deposits (even coarse gravel grounds), salter lands, river-marine sands, degraded lands anthropogenic (artificial slopes, hald, uncovered lands layer of soil, etc.).

As sub-area of vegetation, seabuckthorn gave good results in the forest steppe to the upper limit of the forest. In steppe, the results were poor and the prolonged shortage of water in the soil was observed the dry of seabuckthorn in forest steppe (Traci, C., 1988). In Romania is commonly found naturally or introduced by planting on eroded lands and gravel grounds in Sub Carpathian Mountains area (Vrancea county, Prahova and Buzău Valley) and fluvial-marine sands of the Danube Delta.

The emerging cultures with seabuckthorn from degraded lands was obtained by planting with seedlings in a nursery or with root-shoots of natural regeneration.

The seedlings or root-shoots planting made by different methods depending on the degradation of lands, so that we can draw some conclusions on afforestation techniques:

- planting in ordinary pits, 30 x 30 x 30 cm, 6700 seedlings / ha between terraces that were planted forest species on 3,0 / 0,5 m schedule; on the alluvial deposits, at 1,5 / 1,0 m schedule;
- planting in the cordless, 10000-20000 seedlings / ha;
- planting in slit (slit for planting), 7000-10000 seedlings / ha.

Besides its constituted afforestation material, the seabuckthorn has been used successfully to stabilize / consolidation the lands with

advanced degradation in order to create the conditions for afforestation. Thus, the stems with branches of seabuckthorn were used as “reinforcement vegetable” to consolidation of terraces made on land with active erosion, to the barrages building of local materials (soil or stone) on vegetable support (with branches seabuckthorn) for consolidation / stabilization ravined lands, at defend and consolidation the cliff with fascines longitudinally placed. In all cases, stems and branches of seabuckthorn entered the growing in proportion of more than 40-50% (Traci, 1988) resulting really “antierosional barriers”.

The seabuckthorn cultures have demonstrated a very antierosional efficiency. Having a large suckering capacity, the brushwoods much thicken, well covering the ground and the rich radicular contribute to effective fixing soil. The research conducted had shown that mixtures of Scots and black pine with seabuckthorn lead, under identical conditions, at increases in growth of pines with 20 - 30% higher compared to pure cultures of pine as a result of enrichment in soil nitrogen on symbiosis with actinomycetes.

Besides the antierosional and improvement role, the seabuckthorn has a very high economic value, given by fruits, but the branches and leaves. The fruit production is maintained, in general, quite high, even in the land with excessively degradation, which justifies the culture for this purpose. Research carried out showed that income from exploiting the fruits of seabuckthorn exceed over 10 times the income from selling the wood obtained from pine stands installed on degraded lands with the same station.

ИСПОЛЬЗОВАНИЕ ОБЛЕПИХИ В УЛУЧШЕНИИ ДЕГРАДИРОВАННЫХ ЗЕМЕЛЬ В РУМЫНИИ

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Показана почвозащитная и почвоулучшающая роль облепихи при посадках на деградированных землях на фоне получения дополнительного экономического эффекта от реализации получаемого урожая.

WATER-HOLDING CAPABILITY OF LITTER LAYERS OF ARTIFICIAL SEABUCKTHORN FOREST IN ARSENIC SANDSTONE AREA

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The litter water-holding capability of the litter layer about Seabuckthorn of the arsenic sandstone areas in Dongsheng district, Erdos City was studied. From the static analysis of Seabuckthorn forest in the ecological construction areas, the older the communities Seabuckthorn were, the larger dry material accumulation of litter layer and water-holding rate were, the greater water-holding capacity of litter layer was. The results of gradual regression analysis showed that the factors affecting the water-holding capacity of litter layers of were 99.07% from the dry weight of volume accumulation of litter; site Conditions, age of forest, and the water-holding ratio of litter. From the dynamic analysis, with the immersion time extending, the water-holding capacity of Seabuckthorn litter layers is increasing. When the litter layer is immersed in the water for 8 hours, basically the water-holding capacity reaches stable. With the immersion time extending, the water absorption rate of Seabuckthorn litter layer decreased significantly. The absorbing water rate changes faster in the early (4 hours), and then the rate gradually becomes smooth in the middle time (4-8hours), after 8hours it changes very small. The water-holding of litter layer reached saturation after 24 hours.

Key words: arsenic sandstone area; seabuckthorn; litter layer; water-holding capacity

ВОДОУДЕРЖИВАЮЩАЯ СПОСОБНОСТЬ ПОДСТИ- ЛАЮЩЕЙ ПОВЕРХНОСТИ ИСКУССТВЕННЫХ ОБЛЕ- ПИХОВЫХ НАСАЖДЕНИЙ В ЗОНЕ МЫШЬЯКОВЫХ ПЕСЧАНИКОВ

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Проведены исследования водоудерживающей способности лесной подстилки под искусственными облепиховыми насаждениями в зоне песчаников района Доншенг, Китай. Установлены зависимости водоудерживающей способности от возраста насаждений, общей массы сухого вещества, а также от экспозиции замачивания.

A STUDY ON PHOTOSYNTHETIC CHARACTERISTICS OF SEABUCKTHORN AND MAIN SOIL AND WATER CONSERVATION TREE SPECIES

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The paper aimed to study the characteristics of photosynthetic rate, the transpiration rate and their correlations with the environmental factors of *Populus hopeiensis*, *P. simonii*, *Persica davidiana*, *Armeniaca ansu*, *Caragana* spp., and *Hippophae rhamnoides* in the mixed area with both water and wind erosion in the Loess Plateau by

using Li-6400Q Photosynthesis system. The results indicate that the light saturation points of the six species are so high that they can adapt to the local high lighted climate. The light compensation points of trees are lower than those of the shrubs. The light use efficiency of trees is higher. The diurnal course of net photosynthetic rate of *H. rhamnoides* is double-peak while the diurnal course of net photosynthetic rate of other species is single-peak. And the process is controlled by environmental factors and their physiological functions. The average of diurnal net photosynthetic rate of two poplar trees is 13.8% higher than that of others. The diurnal course of stomatal conductance and intercellular CO₂ concentration for 6 tree species significantly change. The stomatal conductance and intercellular CO₂ concentration of trees are higher than shrubs. And the change is relatively stable. The transpiration rate of six species change significantly. The transpiration rate of two poplar trees is significantly higher than that of other species. The water use efficiency of *P. hopiensis*, *P. simonii* and *C. spp.* are lower than that of the other three species.

Key words: the Loess Plateau; wind-water erosion region; artificial vegetations; Photosynthetic characteristics

ИЗУЧЕНИЕ ПОКАЗАТЕЛЕЙ ФОТОСИНТЕТИЧЕСКОЙ АКТИВНОСТИ ОБЛЕПИХИ, И РОЛЬ ДРЕВЕСНЫХ ПОРОД В СОХРАНЕНИИ ВОДНЫХ И ПОЧВЕННЫХ РЕСУРСОВ

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Проведено изучение фотосинтетической активности, уровня транспирации и их взаимосвязь с экологическими характеристиками *Populus hopiensis*, *P. simonii*, *Persica davidiana*, *Armeniaca ansu*, *Caragana spp.*, and *Hippophae rhamnoides* на территориях, подверженных ветровой и водной эрозии Лессовидного Плато Китая.

SEABUCKTHORN CROSSING BREEDING PROGRESS IN CHINA

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In China the Seabuckthorn breeding programme have been paid a great attention by both researches and government since 1985. Before 2000, the seabuckthorn breeding did much research work on selection breeding from both natural *sinensis* population and Russian varieties introduced seedlings population. Many achievements had been gotten by phenotypes study and selection, such as “Hongxia”, “Wucixiong”, “Zongqiu” from natural *sinensis* population, and “Wulangemu”, “Liaofu No1”, “Liaofu No2” and so on have been selected from the introduced seedlings population of Russian or Mongolian. The second is seabuckthorn gene pools establishment in different places according to their eco-features where they are in Sichuan province, Inner Mongolia autonomous region, which are important for us to create the fine varieties by rich seabuckthorn plasmas. Since 2000, the crossing breeding programme has been carried out and several achievements have been approved, and now getting into experimental extension in certain scale on different eco-types of conditions in Inner Mongolian, Liaoning and Gansu provinces in following years.

РЕЗУЛЬТАТЫ РАБОТ ПО ОТДАЛЕННОЙ ГИБРИДИЗАЦИИ В КИТАЕ

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Представлены результаты работ по межвидовой гибридизации между китайским подвидом облепихи *Hippophae rhamnoides* ssp. *sinensis* и сеянцами от сортов Российской селекции, а также итоги интродукции Российских и Монгольских сортов в Китае.

CULTIVATION / PROPAGATION / HARVESTING

ВОЗДЕЛЫВАНИЕ / РАЗМНОЖЕНИЕ / УБОРКА УРОЖАЯ

NEW EFFICIENT HARVESTING TECHNOLOGY OF CULTIVATED SEABUCKTHORN BERRIES

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There is an increasing commercial interest in IQF (individual quick frozen) seabuckthorn berries for the production of high quality food and cosmetic products. One reason for the limited availability of IQF berries is caused by difficulties in the area of the harvesting process. In terms of cultivated seabuckthorn three different harvesting technologies are known as state-of-the-art: 1. cutting/freezing/shaking technology 2. cutting/shaking technology and 3. shaking/picking on bush. However, only the first two are recommended for cultivated areas due to their cost efficiency.

Looking for cost optimised and efficient harvesting of seabuckthorn plantation we have developed a new patent pending technology based on the cutting/freezing/shaking technology. The presentation will inform about the technical-technological parameters of these harvesting technology and about the results of the last harvesting season 2008 under real field conditions. Compare with the known harvesting technology of Germany the major improvements are (i) a considerable reduction of necessary personnel hours and (ii) a higher

harvesting capacity by faster cutting. The operation of the equipment will be presented in a short video sequence. This technology can be used for all known cultivated varieties and provide a effective harvesting method for seabuckthorn planting farmers.

Key words: seabuckthorn, berries, harvest, plantation

НОВАЯ ЭФФЕКТИВНАЯ ТЕХНОЛОГИЯ УБОРКИ УРОЖАЯ ОБЛЕПИХИ

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Рассмотрена усовершенствованная технология уборки урожая облепихи, заключающаяся в срезке, замораживании и последующем отряхивании. Показаны преимущества новой технологии, ее применимость для большинства известных сортов.

UNDERSTANDING AGRO – TECHNIQUES OF HIPPOPHAE SALICIFOLIA D. DON (SEA BUCKTHORN) OF SIKKIM HIMALAYAS

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Sea buckthorn (*Hippophae salicifolia* D. Don.) locally termed as *Tarobo* (Bhutia), *Ree-singri* (Lepcha) and *Dalle chuk* or *Ghanguru* or *Achuk* (Nepali), is a fascinating, eco-friendly plant species for the

cold Himalayan region. For last few decades, the plant has been gaining wide attractions from researchers and ecologists' world around particularly after its economic potentialities were exposed in biomass production and soil fertility, nutritional and medicinal values. The dry temperate hills of north Sikkim are the natural habitat of *Hippophae salicifolia* D. Don. This species in Sikkim is mostly observed to be growing in the in the elevation ranging from 7845 to 10206 ft. and is colonized at either side of riverbank in both Lachung and Lachen valley of north Sikkim in an approximate area of 500ha. Field observation on *Hippophae salicifolia* D. Don also revealed to be growing mixed with *Alnus nepalensis*, both having a nodulated roots, at an altitude of 7845 ft.

From the present study in *Hippophae salicifolia* D. Don, it was observed that the plant is not very big in size but trees up to 15 meters have been recorded. The ripe fruit is 4-6mm length and 3-6mm in width with orange red colour contained various compounds like vitamin 'C' (300-1600mg/100g), Vitamin 'E' (200mg/100g). Lycopene, Flavonoid (0.2% in juice), Amino acid, etc. The study of germination performance of seeds in different soil media was studied; fertile and brown soil media gave good result. Rooting and callus formation using hormones like IBA, NAA & IAA in different concentrations (ppm) showed interesting growth results, in which IBA (55 – 60 ppm) showed more callus formation and rooting within three months. Studies were also carried out in different chemicals for germination of seeds of sea buckthorn where GA3 (700 ppm) treated seeds germinated in eight days compared to 17 days in water alone (control). Further response of hormones in root growth showed that IAA at 100 ppm showed 9.4 cm mean root length. This type of study, for plant with high economic potential, can lead to the better understanding and management in the natural condition.

Key words: *Hippophae salicifolia* D. Don, Dalle-chuk, Lepcha, Nepali, Bhutia, sea buckthorn, hormones, soil, nodulated.

**АГРОТЕХНИКА ВОЗДЕЛЫВАНИЯ
HIPPOPHAE SALICIFOLIA D. DON
В ГИМАЛАЯХ ШТАТА СИККИМ**

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Проведена всесторонняя оценка *Hippophae salicifolia* D.Don., являющегося широко распространенным подвидом в Гималаях, с целью разработки оптимальных агротехнических приемов возделывания.

Изучен процесс прорастания семян в различной почвенной среде, а также формирование каллуса и корневой системы при использовании ИМК, ИУК и НУК в различных концентрациях.

**FUNGY GENUS FUSARIUM – INJURIOUS PATHOGENS
OF SEA-BUCKTHORN**

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Introduction in culture of sea-buckthorn at change of soil-climatic conditions of growth promoted occurrence of new specific structure of pathogenic microflora.

Inspection of collection plantings of sea-buckthorn berries on sites nursery CBG of NAS of Belarus is spent.

Phytoexamination of seeds from the damaged sea-buckthorn berries has shown, that fungus genus fusarium have appeared the most

widespread and harming. From such seeds there are ill seedlings. At strong defeat seeds lose germination. Infecting agents: *F.avenaceum* (Fr.) Sacc., *F.solani* App. et. Wr., *F. sambucinum* var. *minus*, *F.culmorum*.

Activators *Botrytis cinerea* Fr., *Alternaria* Nees, *Trichothecium roseum* Lk. are found out also on the surface of seeds. The infected with these activators seeds are viable, but they have low reproductive qualities.

At studying of a phytosanitary condition of seeds of different ecotypes it is not revealed sharp distinction in specific structure of activators of illnesses, except fungus *Alternaria* Nees. These fungus allocated from sick seeds of sea-buckthorn various ecotypes, differed to the morphological signs.

Signs of diseases on sea-buckthorn seedlings which were shown in loss of leaves and withering of branches are found out. The mycological analysis parts of plants seedlings with signs of diseases has shown presence of fungus genus *Fusarium*: *F. oxysporum* var. *orthoceras*. Disease activators caused defeat of vascular system of plants.

Inspection of plantings of sea-buckthorn (3-8-year saplings) has revealed damages of branches (skeletal and growing) and trunks in the form of ulcers, longitudinal strips and whitening barks. The mycological analysis of the damaged parts of plants has shown presence of following kinds of fungies: *Fusarium culmorum* (W.G.Sm.) Sacc. And *F. sambucinum* Fuck. var. *minus* Wr. The mycological analysis of soil in a zone of root system of the dried up plants of sea-buckthorn berries has revealed presence of fungus *Fusarium oxysporum* var. *orthoceras*. In damp weather in places of defeat of plants the touch a white-pink touch is found out.

On the basis of phytopathologic inspection of plantings of sea-buckthorn in the dendrology nursery CBG of NAS it is established, that withering and drying up of plants cause growth fungus genus *Fusarium* which have been allocated from various parts of plants.

Key words: sea-buckthorn, seeds, seedlings, pathogenic fungus, Belarus.

ГРИБЫ РОДА ФУЗАРИУМ – ВРЕДЯЩИЙ ПАТОГЕН НА ОБЛЕПИХЕ

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В работе приведен анализ фитопатогенной микрофлоры на растениях облепихи в саду Центрального ботанического сада академии наук Беларуси при интродукции облепихи из других регионов. Установлено, что основным вредящим фактором, влияющим на процессы усыхания облепихи, являются грибы рода *fusarium*. Показано их накопление в различных частях растения облепихи.

TRIALS RESULTS OF THE COMBINE “JOONAS-2000” (FINLAND) AT SEA-BUCKTHORN HARVESTING

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Nowadays, demand for products with the content of sea-buckthorn grows greatly. It is provided by medicinal properties of the crop. Sea-buckthorn is used not only in food, but pharmaceutical and cosmetic industries.

The main factor, restraining the expansion of sea-buckthorn area, is the absence of the means for machine harvesting.

In 2007 and 2008 research and production trials of Finnish berry-harvesting combine “Joonas-2000” were performed. The combine of portal type operates on the plantations with inter-row spacing

not less than 3.5 m on even plots, catching the harvest on the height of not lower than 0.4 m. Self-propelled combine consists of portal chassis and harvesting modulus. Taking off fruits is carried out by vertical drums-activators with plastic fingers at vibration of bushes crown, embracing the last ones from two sides. A pair of activators, acting on crown branches with vibrating fingers, shakes berries, which fall on two catching transporters.

Estimate of new varieties and hybrids of sea-buckthorn, available for machine harvesting, envisaged completeness of taking off fruits from bushes according to program and methodic, loss level of the harvest on the ground, the degree and any kind of branch injuries of different order and age, the quality of heap, the form of bushes crown.

“Joonas-2000” trials are performed with different varieties and hybrids, on different stages of fruit ripeness and on sea-buckthorn plantations of different age. It was collected approximately 20 t of sea-buckthorn berries for the period of combine operation during two seasons.

During combine trials and operation we received satisfactory results of machine harvesting at minimum injuries of sea-buckthorn branches.

The analysis showed, that plants endure the action of working organs well and drying of plants was not found out. The combine performs stable technological process, with principal efficiency, but it should be developed and carry out further trials on special sea-buckthorn plantations with new variety-specimens, tearing-off effort of fruits should be 1.0 – 1.2 H and the mass of fruits up to 1.0 g.

It is stated, that taking-off fruits depends on the following factors: mass of fruits, tearing off effort and ripeness stage, density of fruits location on a branch; diameter and elasticity of a branch of the lower order; crown form, quantity, dimensions and elasticity of skeleton branches; total mass of a wood, mass of the harvest, the height of its location and other factors.

Machine harvesting increases productivity of labour in 30-43 times.

Key words: combine, sea-buckthorn, harvesting, chassis, trials, injury, vibrating fingers, heap.

**РЕЗУЛЬТАТЫ ИСПЫТАНИЙ
КОМБАЙНА «ИООНАС-2000» (ФИНЛЯНДИЯ)
НА УБОРКЕ ОБЛЕПИХИ**

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Приведены результаты научных и производственных испытаний ягодоуборочного комбайна «Йоонас-2000» (Финляндия) на уборке облепихи. Получены удовлетворительные результаты машинной уборки на отдельных сортообразцах облепихи различного возраста при минимальных повреждениях ветвей. При этом производительность на сборе увеличивается до 30-43 раз.

**PREPARATIONS OBTAINED FROM CONIFERS
IN REPRODUCTION OF SEA BUCKTHORN**

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It is known that sea buckthorn may be reproduced by generative and vegetative way. In Novosibirsk region reproduction of sea buckthorn usually is made with hardwood cuttings. It is a great problem to decrease the death of cuttings during rootage and replanting. Use of growth substances is advisable for better survival of seedlings.

In our experiments the efficiency of some preparations on survival of seedlings under theirs replanting from hotbeds to experimental fields was studied.

Preparations obtained on the base of substances from conifers such as Novosil and Raststim were used in the experiments. Treating of seedlings by these regulators was made in autumn before their replanting. The account of survived plants was conducted in the next year.

Results of the field experiments showed that coniferous regulators increased quantity of survived seedlings. The average value per preparations showed increase of quantity of survived seedlings in variety Zyryanka up to 10%, in variety Zarnitsa up to 8,7 %.The most efficient consumption rate of preparations that increased seedling survival on 10,45% was 500 ml/ha,

Thus, coniferous preparations increasing quantity of survived plants of sea buckthorn are advisable when seedlings are replanted to field.

Key world: sea buckthorn, seedlings, survival, growth regulators, conifers

ИСПОЛЬЗОВАНИЕ ПРЕПАРАТОВ, ПОЛУЧЕННЫХ ИЗ ХВОЙНЫХ ПОРОД, ПРИ РАЗМНОЖЕНИИ ОБЛЕПИХИ

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Представлены результаты изучения эффективности препаратов Новосил и Растстим, полученных на основе экстракта хвойных пород, на приживаемость саженцев облепихи при их пересадке из теплицы в поле.

THE RESULTS OF INVESTIGATIONS IN SEA-BUCKTHORN MECHANIZED HARVESTING

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Sea-buckthorn is very important for Siberian horticulture not only because of biochemical composition, but regular stable fruit bearing as well. One of the main reasons, restraining the expansion of the area is low labour productivity at harvesting. 80% of all costs are spent for manual harvesting at sea-buckthorn production. So for increasing the gross yield, along with the expansion of the area and development of new varieties it is necessary to solve the question of machined harvesting as soon as possible.

Analysis of works in searching for technical means of sea-buckthorn harvesting showed, that vibrating method is the most available. For ensuring full gathering of sea-buckthorn fruits, no less than 80%, one should have compact crown, with a small quantity of skeletal branches, a small angle of declination (not more than 35°), hard crown, so that under the heavy harvest branches could not droop. The mass of a fruit should be not less than 0.6 g, the length of a fruitstalk not less than 4 mm, tearing-off effort not more than 180 g, peel firmness not less than 48 g/mm², with a rare ear of fruits.

In 2006 harvesting of the variety Elizaveta and hybrids 722-77-1, 1240-81-1 was carried out in three-year sea-buckthorn plantation by experimental specimen of combine SVK-4D. In 2007, 2008 trials of Finnish fruit-harvesting combine “Jonas-2000” were performed on the following variety-specimens such as Altaiskaya, Chuiskaya 722-77-1, 1240-81-1, 53-86-1, 1320-85-1, 1170-86-1.

Evaluating the state of the plants after three-time harvesting of sea-buckthorn, it should be noted, that the yield of hybrids 1240-81-1 and 722-77-1 was reduced by 4-28%. As for the variety Elizaveta, the yield after combine harvesting was of the same level as at manual gathering of fruits. It is connected with the fact, that the variety Eli-

zaveta is rather tall and at manual gathering the trees are strongly broken off, that leads to reducing of the yield.

Preliminary investigations of vibrating method of sea-buckthorn combine harvesting proved the possibility of machined harvesting of sea-buckthorn, plants don't die, but the yield reduces from 4 up to 28%, mainly, due to the removal of annual shoots. We haven't found the variety, corresponding to all the requirements of combine harvesting.

In physical-mechanical properties of fruits the variety Elizaveta corresponds to the requirements, but because of high height can't be consider as a promising one. Weather-climatic conditions of the other variety-specimens lead to change of a mass of fruits, tearing-off effort, productivity of shoots, so in separate years shaking of fruits becomes lower.

That's why there is a need in further investigations, directed on searching of available sea-buckthorn variety-specimens for machined harvesting.

Key words: sea-buckthorn, investigations, harvesting, combine, yield, variety-specimen, development, tearing-off effort

СОСТОЯНИЕ ИССЛЕДОВАНИЙ В ОБЛАСТИ МЕХАНИЗИРОВАННОЙ УБОРКИ УРОЖАЯ ОБЛЕПИХИ

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Установлены оптимальные физико-механические параметры сортообразцов облепихи по пригодности к наиболее приемлемому для изучаемого подвида облепихи вибрационному способу уборки урожая. Результаты предварительных исследований не выявили ни одного сорта облепихи, полностью отвечающего поставленным требованиям.

SEA-BUCKTHORN PESTS AND DISEASES AT ALTAI

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The most dangerous and widely-spread pests among specialized pests' species in conditions of Altai region are: sea-buckthorn fly – *Rhagoletis batava obscuriosa* Kol. and sea-buckthorn gall mite – *Aceria hippophae* Nal.

The following specialized species don't do much harm: sea-buckthorn psylla – *Psylla hippophaes* Frst., green sea-buckthorn aphid – *Capitophorus hippophaes* Walk., sea-buckthorn cotton-stem moth – *Gelechia hippophoeella* Schrk., sea-buckthorn shoot moth – *Anarsia elegnella* W. Kusn. From the number of multi-poisonous pests in the years of mass propagation the following pests can do a significant harm: *Phyllobius pyri* L., *Lexostege sicticalis* L., *Ocneria dispar* L., *Melolontha hippocastani* F., *Cossus cossus* L., *Orgyia gonostigma* L., *Euproctis similes* Fssl., *Otiorrhynchus ligustici* L.

The other arthropods phytophages are found out in sea-buckthorn: *Caeoecia podana* Sc., *Barathra brassica* L., *Tentredo vespa* Retz., *Phyllopertha horticola* L., *Anarsia elegnella* Kuzn., *Semiothisa notata* L., *Arctia caja* L., *Cassida nebulosa* L., *C. rubiginosa* Müll., *Hypocassida subferruginea* Schrank., *Apion flavipes* Paur., *Byctiscus betulae* L., *Lochmaea crataegi* Forst., *Palomena prasina* L., *Eurydema oleracea* L., *Dolycoris baccarum* L., *Carpocoris fuscipinus* Boh.

The most widely-spread sea-buckthorn disease in commercial plantations is drying (pathogens – fungi from genus *Verticillium* Nees. и *Fusarium* Link.). In separate years «endomycosis» of fruits does a significant harm. The disease is caused by saprophyte microflora, represented by the following species: *Aureobasidium pullulans* (D.B.) Ar., El., *Penicillium cyneotulvum* B., Rap., Thoms, *Penicillium rubrum* Stadt, Rap., Thoms., *Aspergillus niger* V. Fieg., Rap., Fen., *Trichoderma viride* Pors, Ritai., *Alternaria alternata* (Fr.) Keissler.

Four species of fungi have been found out with properties of obligate saprophites: *Botritis cinerea* Pers. ex Fr., *Capnodium* Sp., *Monilia altaika* A. Zukov., *Penicillium hordei* Stolk.

ВРЕДИТЕЛИ И БОЛЕЗНИ ОБЛЕПИХИ НА АЛТАЕ

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Представлены вредители и болезни, распространенные в той или иной степени на облепихе в условиях Алтайского края. Выделены наиболее вредоносные.

ENVIRONMENTALLY-FRIENDLY METHODS OF MAIN SEA-BUCKTHORN PESTS PROTECTION

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In conditions of Altai region the main harmful object in sea-buckthorn commercial plantations is sea-buckthorn fly – *Rhagoletis batava obscuriosa* Kol., capable to damage to 90-100% of the harvest in the years of mass propagation.

The main problem of the harvest protection – residue of pesticides in fruits.

At the RI of horticulture for Siberia ecologically safe method of sea-buckthorn protection from sea-buckthorn fly is worked out,

which guarantees the harvest without toxic residua. The given method is based on the application of biological preparation Phytoverm. From two tested preparative forms, 1% of c.e. Phytoverm in a concentration of 0.3% gave the best result. Spraying with this preparation two times ensures 100% keeping of the harvest. At excessive irrigation of fruits before treatment the efficiency of the preparation is reduced.

As for sea-buckthorn nursery, sea-buckthorn gall mite reduces the productivity of mother plantations and aggravates the quality of planting material. It is propagated with seedlings, so the main method of fighting with the pest-disinfection of planting material. The investigations showed non advisability of disinfection of sea-buckthorn soft-wood cuttings from gall mite.

At disinfection of rooted cuttings and two-year sea-buckthorn seedlings method of plants soaking in 0.4% of oil emulsion for 5 hours was the best. The efficiency was the highest. The optimum time of treatment – spring, ensuring high level of profitableness: in rooted cuttings – 352%, in two-year seedlings – 349%.

ЭКОЛОГИЧЕСКИ БЕЗОПАСНЫЕ МЕТОДЫ ЗАЩИТЫ ОБЛЕПИХИ ОТ ОСНОВНЫХ ВРЕДИТЕЛЕЙ

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Приведены результаты испытания эффективности биологического препарата Фитоверм при борьбе с наиболее вредоносным объектом плодоносящих облепиховых плантаций в условиях Алтайского края – облепиховой мухой. Предложены способы контроля галлового клеща в питомнике облепихи посредством дезинфекции посадочного материала.

ENVIRONMENT-FORMING SIGNIFICANCE OF SEA-BUCKTHORN IN GARDENS OF WESTERN SIBERIA

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For the last decades sea-buckthorn has become a priority crop in commercial gardens of Siberia. For all this, the quantity of sea-buckthorn plantations increases not only in traditional plantations of commercial type, but in gardens of medicinal crops as well, which are actively established by special companies, making different medicinal preparations.

This circumstance intensifies demands to the quality of production. So it is more promising to grow sea-buckthorn, first of all, in boundaries of the bioclimatic beam in the southern regions of Western Siberia, where the most favourable level of biochemical connections (carotenoids, tocopherols, flavonoids and others) is accumulated in fruits of the crop.

Behind the limits of the above-mentioned natural province a lack of warm and sunny light is observed in the North and surplus, leading to fruits degradation – in the South.

Over-ground organs of sea-buckthorn plants make a contribution to the environment remaking, first of all, as powerful turbulizators, they contribute to active retention of winter precipitations at the period of wind-snowy flows. At the presence of free snow-collecting area from the side of snow transference, high powerful snow-drifts are formed in the first rows of plants, that leads to snow-breaking, surface discharge, development of soil erosion, and these phenomena can be eliminated by using special system of measures.

Among intensification methods of sea-buckthorn cultivation in conditions of a steppe with plots of vegetation and a forest-steppe of Altai it is necessary to pay attention to water ensuring, which can be seen well at additional supply of water not less than 4.0-4.6 thousands m³/ha. It is desirable to regulate estuary irrigation on chernozem soils owing to the application of spring flow.

The given measures increase the yield up to 28...42 t/ha a year at application of sea-buckthorn varieties of intensive type. Estuary irrigation is mostly effective in plantations with thick planting in a garden.

In plantations with limited catchment area as well as on slopes of small steepness it is more promising to use basins of constant action, made with the help of bulldozer. Sea-buckthorn plants positively respond on autumn deep annual loosening of soil in the centre of inter-rows.

СРЕДООБРАЗУЮЩАЯ РОЛЬ ОБЛЕПИХИ В САДАХ ЗАПАДНОЙ СИБИРИ

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Показана средообразующая роль облепихи, отмечены наиболее подходящие территории сада для выращивания культуры в условиях метельного снегопереноса. Установлена возможность повышения урожайности культуры до 42 т/га за счет мелиоративных мероприятий способствующих задержанию талых вод.

MICROPROPAGATION AS A SOURCE OF PLANTING MATERIAL FOR ROMANIAN SEABUCKTHORN (HIPPOPHAE RHAMNOIDES L. SSP. CARPATICA)

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The commercial interest for the seabuckthorn berries has increased constantly during recent years, and consequently a growing number of small-scale seabuckthorn cultures have been established.

However, the number of large-scale seabuckthorn orchards in Romania has remained insignificant, mainly due to the lack of reasonably priced and disease-free high quality planting material obtained from highly productive locally adapted varieties. Seabuckthorn orchards were usually established with plants obtained through hardwood cutting from only nine female certified varieties.

In this study we explore the potential of *in vitro* cultures derived from apical meristems as a source of planting material for seabuckthorn orchards. This method guarantees that the planting material is disease-free and highly uniform. The high multiplication rate will also ensure a low final cost of the material. As a source for our experiments we used more than 50 three-year-old suckers collected from seabuckthorn (*Hippophae rhamnoides* L. ssp. *carpatica*) individuals from the Danube Delta. We collected suckers from both female and male individuals with a vigorous phenotype and abundant fructification (in the case of female individuals) to increase the probability of obtaining material of high economical value. We sterilized superficially the dormant buds with detergent and chlorine-based commercial substances, and then rinsed them several times with sterilized water. We then collected apical meristem explants with sizes between 0,5-1 mm, which we placed in woody plant media (WPM) with various concentrations of agar, phytohormones (BAP, Kinetin, TDZ, IBA, IAA), and pH levels. The photoperiod we used was set to 16/8 hours at a room temperature of 22-24°C. Culture initiation and multiplication were particularly successful for female individuals, and more modest for male individuals. We are currently exploring new media characteristics to improve the efficiency of culture initiation for male individuals. Two female lines that showed the best success rate at culture initiation and multiplication will be further used to test various rooting protocols.

In conclusion, we show that micropropagation can be used to establish seabuckthorn cultures, with the highest success rate being currently obtained for a few female individuals. Our results show that varying the culture media conditions will likely result in an increased success in initiating cultures from male individuals and a larger panel of female seabuckthorn individuals.

Key words: Seabuckthorn, micropropagation, apical meristems, explant, phytohormones, culture media

МИКРОРАЗМНОЖЕНИЕ КАК ИСТОЧНИК ПОСАДОЧНОГО МАТЕРИАЛА ОБЛЕПИХИ ДЛЯ РУМЫНИИ

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Приведены результаты экспериментов по размножению мужских и женских форм облепихи *Hippophae rhamnoides* L. ssp. *carpatica* в культуре тканей с использованием апикальных меристем. Показана их эффективность, предложены оптимальные концентрации фитогормонов и pH среды для процессов инициации.

SYMPTOM AND PATHOGEN IDENTIFICATION OF DRIED-SHRINK DISEASE OF *HIPPOPHAE* L. AND PRIMARY SELECTION OF RESISTANT VARIETIES *Cheng-Jiang RUAN*¹, *Ming-Yue Huang*^{1,2}, *He Li*²

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Sea buckthorn (*Hippophae* L.) is a species which has high economic values as a new commercial berry crop and eco-environmental importance in protection against wind, prevention of sand drift and soil & water conservation. Dried-shrink disease, which is named as cancer for sea buckthorn, is a most serious disease of sea buckthorn.

It decreases 20-40% yield and leads sea buckthorn plantations to die at a large-scale (e.g. over 10000 hectares per year in China). At present, dried-shrink disease is being a bottle-neck restricting sea buckthorn industry. In this study, we investigated symptom and pathogenous law of dried-shrink disease of sea buckthorn, isolated and identified its pathogens, and measured disease index of different sea buckthorn varieties. The results showed: (1) At the primary stage of dried-shrink disease, infected parts appear sporadic yellow-dots, then which gradually swell and craze; after gaping disease-dots augment, infected parts gradually blet, black, dry and shrink, eventually forming disease patch; after this, leaves become into yellow and gradually fall off, growth vigor weaken, and fruit appears un-normally early mature. With the development of dried-shrink disease, barks of infected parts craze and blet, which lead plants to die; (2) Infection of dried-shrink disease of sea buckthorn mainly occurs on the tree-neck, and plants infected dried-shrink disease are over three years old. Death of parts above tree-neck does not influence on roots vitality, which can re-germinate and generate new plant. Death of ramets on the same genets does not influence each other; (3) Combining morphological characters and sequence of ITS, we identified four pathogens causing dried-shrink disease of sea buckthorn; and (4) Varieties with high resistance to dried-shrink disease, which were selected by disease index, have Yalishanda 2, Wucixiong from China, Liusha 2, etc; varieties susceptible to dried-shrink disease have Hongmaoxiong, Chengsi, Liusha 1 and Aliyi, etc. This data provide materials and basic for understanding and studying pathogenous mechanism of dried-shrink disease of sea buckthorn, cloning gene with resistance to dried-shrink disease and breeding varieties with resistance to dried-shrink disease.

Key words: *Hippophae* L.; dried-shrink disease; symptom; pathogenous law; pathogen; primary selection of varieties with resistance to dried-shrink disease

СИМПТОМАТИКА И ИДЕНТИФИКАЦИЯ ПАТОГЕНОВ УСЫХАНИЯ ОБЛЕПИХИ. НАЧАЛЬНАЯ СЕЛЕКЦИЯ НА УСТОЙЧИВОСТЬ

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Показана серьезная опасность распространения усыхания на облепихе в Китае. Проведено изучение течения болезни, выявление патогена. Отобраны сорта с относительной устойчивостью к болезни.

STATUS OF HARVESTING TOOLS FOR SEABUCKTHORN FRUIT AND ITS ADOPTION IN NORTH WESTERN HIMALAYAS OF INDIA

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The harvesting of seabuckthorn fruits is the most difficult operation due to small size and stickiness of soft fruits and thorny nature of the bush. In India, an area of 12000 ha is under seabuckthorn, mostly in Ladakh and its fruit ripe during September. At present, the harvesting of fruits are performed manually by beating the branches of seabuckthorn with a stick and breaking off the branches from the mother plant in which a person can harvest 2 kg and 3 kg of ripe fruits per hour, respectively. However, the plant is severely damaged particularly in case of breaking off branches. In this regard, a critical review study has been done to know the overall development of harvesting of berries with limitations and its adoption particularly in north western Himalayas of India. Because of the inherent difficulties of fruit har-

vesting, two main principle i.e. direct and indirect harvesting technologies have been tried globally. Direct harvesting is the stripping or combing of fruits mostly with the help of hand devices when branches are at low level. Robot harvesters are also developed for direct harvesting but efficiency is very low and costly. Machines are used for indirect harvesting method where it is done by shaking of main branches of trees or long bushes and it was started in Michigan at the end of 1950's. To detach the berries from trees, suction type harvester was also used. The out put and efficiency of the entire mechanical harvester is dependent upon variety, potential yield, spacing between rows and size of plants. It was also found that mechanical harvester of seabuckthorn can't be used in wild grown plant as there is no spacing from plant to plant and row to row. Hence, it is very difficult to move in between the plant for harvesting fruits.

The concept emerged from the study shows that comb and shaker type manual harvester has potential for adoption in harvesting seabuckthorn berries in north western Himalayas of India. Thus, an indigenous manual harvester is being developed for increasing capacity and efficiency, which is simple in design, cost effective and has minimum drudgery, to make the harvesting operation easier, simpler and more attractive to the users. The main features of the harvesters are adjustable comb and lever for proper griping. The handle length of the harvester is 1 meter and light in weight.

СРЕДСТВА ДЛЯ УБОРКИ УРОЖАЯ ОБЛЕПИХИ, ИХ АДАПТАЦИЯ К УСЛОВИЯМ ЗАПАДНЫХ ГИМАЛАЕВ ИНДИИ

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Проведена оценка возможности применения различных технических средств и приспособлений для уборки урожая облепихи. Выявлена их низкая пригодность к условиям Западных Гималаев Индии, где расположены основные массивы облепиховых зарослей. Предложена местная разработка, отличающаяся легкостью производства и удобством в применении.

ARBUSCULAR MYCORRHIZAL SYMBIOSIS OF SEABUCKTHORN IN SWEDISH SOILS

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Arbuscular mycorrhiza (AM) is a symbiosis between plants and fungi of the order Glomeromycota. AM is known to have positive effects on its host plants such as improved mineral nutrient uptake and protection against pathogens. Seabuckthorn (*Hippophae rhamnoides* L.), as most other plants, has been found to form AM, but this has received less attention. In this study we investigated the occurrence of infective AM fungi in soils at a few sites in different parts of Sweden. At these sites seabuckthorn either grows naturally or has been cultivated in agricultural soils. At one site with natural populations along the Uppland coast, Sweden, on the shore of the Gulf of Bothnia, several samples were collected along an ecological gradient. Rhizosphere soil of seabuckthorn was collected and used as inoculum in controlled conditions. Several genotypes of seabuckthorn were used as host plants in the trap cultures. Colonization of roots and various fungal morphological stages were estimated. Taxonomic identification was carried out based on spore morphology. The overall most abundant AM fungal spores were identified as *Glomus constrictum*, *G. fasciculatum* and *G. hoi* and other *Glomus* sp.

Key words: arbuscular mycorrhiza, seabuckthorn, symbiosis, *Glomus*, Sweden

ПРОЯВЛЕНИЕ СИМБИОЗА НА ОБЛЕПИХЕ В УСЛОВИЯХ ПОЧВ ШВЕЦИИ

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Изучен видовой состав микоризной микрофлоры на облепихе в различных почвенных провинциях Швеции. Установлено, что наиболее общими являются грибы *Glomus constrictum*, *G. fasciculatum* и *G. hoi*, а также другие подвиды *Glomus*.

ASSESSMENT OF BEST VEGETATIVE PROPAGATION PROTOCOL OF *HIPPOPHAE SALICIFOLIA* IN CENTRAL HIMALAYA INDIA

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India

Present research was investigated to determine the best vegetative propagation protocol as well as elite genotype of *H. Salicifolia* for conservation, cultivation and degraded land rehabilitation programme in Central Himalaya India. Effect of different concentrated doses of auxins, male and female cuttings (sex of donor plant) and rooting media (pure soil and equal ratio of soil and sand) on rooting percentage, root per shoot, root length and root diameter of stem cuttings was examined. The application of lower concentrated doses (25 and 50 ppm) of various auxins provides better results of vegetative propagation rather than higher concentrated doses (100, 300, 500 and 1000 ppm). Female cuttings exhibited maximum of 83.33 ± 3.33 % rooting in comparison to 70.00 ± 5.77 % of male cuttings. Cuttings planted in sand: soil rooting media showed the better vegetative propagation results (for rooting percentage, root per shoot, root

length and root diameter) than the cuttings planted in soil media. The experimental study clearly indicated that the best vegetative propagation results can be achieved by the application of NAA 50 ppm under the soil: sand rooting media. The results also provide a considerable guidance towards the successful propagation protocol for large scale cultivation of this species for orchard development under horticultural model, afforestation, rehabilitation and conservation of degraded lands in higher Himalayan region.

**ПОИСК ОПТИМАЛЬНЫХ СПОСОБОВ
ВЕГЕТАТИВНОГО РАЗМНОЖЕНИЯ
HIPPOPHAE SALICIFOLIA
В УСЛОВИЯХ ЦЕНТРАЛЬНЫХ ГИМАЛАЕВ ИНДИИ**

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Индия

Изучено влияние концентрации ауксинов, состав почвенного субстрата, особенностей мужских и женских растений *H. Salicifolia* на процессы окоренения. Рекомендованы оптимальные параметры.

SEA BUCKTHORN CULTIVATION IN TURKEY

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The Coruh valley is accepted one of the 34 hotspots in terms of plant biodiversity in the world. Along with the other plants, the valley has a important source of wild edible fruits. In recent years

throughout the world there is an increasing demand to these kind of fruits because of high health components of these fruits. On the other hand, these fruits does not sprayed any chemicals etc. Therefore they can accept natural fruits. In these study, horticultural characteristics and chemical content of 6 selected sea buckthorn genotypes from the region were investigated. The total phenolic content of the berries ranged from 18.25 mg gallic acid equivalents (GAE) per g dry weight basis to 62.13 mg GAE per g. The highest antioxidant activity was 94.44% (similar to the standard BHT at 200 mg/L) and the lowest was 83.77%. The major fatty acids in berries were palmitoleic acid, followed by palmitic acid, oleic acid and linoleic acid. Total soluble solid content of sea buckthorn genotypes varied from 11.22 to 15.60%, titratable acidity varied from 2.77 to 4.07%, the pH varied from 2.68 to 3.03 and Vitamin C varied from 77 to 85 mg/100 mL.

Key words: sea buckthorn, antioxidant activity, vitamin C.

ВОЗДЕЛЫВАНИЕ ОБЛЕПИХИ В ТУРЦИИ

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Изучены хозяйственно-биологические и биохимические особенности шести форм облепихи, произрастающей в экологически чистых условиях долины Корух, Турция.

INFLUENCE OF DIFFERENTIATED CULTURE PROCEDURES ON THE YIELD OF SEA BUCKTHORN - FIRST RESULTS OF A FIELD EXPERIMENT IN BERLIN-DAHLEM

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Sea buckthorn (*Hippophae rhamnoides* L.) is cultivated in Germany frequently on border areas of agronomic utilization. Thereby, the yields strongly depend on the cultivation methods and the used cultivars. About the cultivars 'Sirola' and 'Habego' licensed in 2006, no comparative cultivation experience is present so far. The effects of differentiated cultivation methods on the yield are to be examined in a long-term field experiment. Within this test, the strength of regeneration and opportunities of machine harvesting are also examined.

In October 2005, an attempt with the cultivars 'Hergo', 'Askola', 'Habego' and 'Sirola' was carried out in Berlin-Dahlem. Apart from the cultivars, there are further test members:

B) Soil cover (B1 – soil without cover, B2 - cover with woodchips, B3 – plastic ground cover with woven fabric);

C) Irrigation (C1 – without irrigation, C2 – with irrigation).

The test range is designed as a gap plant with 4 repetitions, for each attempt member 6 plants were used. The examination concentrates on growth and yield. In addition, the phytosanitary status of the bushes is determined and fruit content investigations are made.

The shoot growth of the cultivar 'Askola' is strongest, followed by 'Habego', 'Hergo' and 'Sirola'. A clear increase of shoot growth was reached by a cover with woodchips, likewise by irrigation. The highest fruit yield was achieved by the cultivars 'Hergo' and 'Askola', the yields of the new cultivars 'Habego' and 'Sirola' were significantly lower. When comparing the soil covers, the variant covered with woodchips produced significantly higher fruit yield compared with the variant without soil cover and plastic ground cover. On the average of all variants, a 2.5 fold yield increase was obtained with irrigation in relation to the variants without irrigation.

ВЛИЯНИЕ РАЗЛИЧНЫХ АГРОТЕХНИЧЕСКИХ ПРИЕМОМ НА УРОЖАЙНОСТЬ ОБЛЕПИХИ – ПЕРВЫЕ РЕЗУЛЬТАТЫ ПОЛЕВЫХ ЭКСПЕРИМЕНТОВ В БЕРЛИНЕ

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Приведены результаты изучения влияния орошения и различных способов мульчирования приствольных полос, на продуктивность лучших сортов облепихи немецкой селекции в условиях Берлина. Проведена оценка пригодности сортов к машинной уборке, а также их восстановительная способность после срезки ветвей.

DEVELOPMENT OF MALE GAMETOPHYTE OF SEABUCKTHORN HYBRIDS OF DIFFERENT ECOLOGICAL–GEOGRAPHICAL ORIGIN IN NIZHNY NOVGOROD (RUSSIA) REGION

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Development of anther from *Hippophaë rhamnoides L.* occurs in two phases: the first phase of development runs from late July to October, while the second stage – in the spring of next year. In literature there are no data on the effect of the sum of positive temperatures on the development of male gametophyte in spring. In this regard the

aim of this work was to establish the influence of spring temperature on microsporogenesis of *H.rhamnoides* hybrids of different eco-geographical origin in Nizhny Novgorod region.

The objects of research were the anthers of *H. rhamnoides* hybrids of different eco-geographic origin.

It was determined that the course of individual stages of microsporogenesis and microgametogenesis depends on the location of inflorescences in the crown bush, as well as the location of buds in the inflorescence. Microsporogenesis began in few days earlier in the lower inflorescence buds than in higher-lying buds of the same inflorescence.

Thus, as a result of the research it was able to identify two groups of hybrids of *H. rhamnoides* differed in the periods of beginning and course of individual stages of microsporogenesis, depending on the sum of positive temperatures in the spring. In hybrids with the parental forms of Siberian (Katunsky) ecotype meiosis began in a few days earlier, when the sum of positive temperatures was equal to 49-500C, than that of hybrids with one parent Baltic ecotype – with the sum of positive temperatures 62-710C.

Formation of microspor tetrads in hybrids involving Katunsky ecotype begins typically at an earlier date, when the sum of positive temperatures usually is 115-1190C; while hybrids with Baltic ecotype with the sum of temperatures of temperatures 136-1470C.

On observations made in 2005-2007, it was determined that ripe pollen with two nucleus in all the investigated hybrids was formed with the sum of positive temperatures of 172-2170 C. Pollination begins almost simultaneously in all investigated hybrids, with the sum of positive temperatures 276-3440C.

Flowering (pollination) of male plants in studied hybrids and ecotypes begins almost simultaneously and depends on weather conditions in this period.

Key word: Sea buckthorn, hybrids, pollen-grain, viability.

**РАЗВИТИЕ МУЖСКОГО ГАМЕТОФИТА
ГИБРИДОВ ОБЛЕПИХИ РАЗЛИЧНОГО
ЭКОЛОГО-ГЕОГРАФИЧЕСКОГО ПРОИСХОЖДЕНИЯ
В РАЙОНЕ НИЖНЕГО НОВГОРОДА, РОССИЯ**

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Приведены результаты изучения влияния погодных условий в начале вегетации на развитие микроспорогенеза у различных эколого-географических групп облепихи в условиях Нижнего Новгорода. Установлены существенные различия в темпах развития микроспорогенеза в зависимости от подвида облепихи, расположения початка в кусте, а также непосредственно почки в самом початке.

**IN VITRO REGENERATION METHODS
FOR SEABUCKTHORN (*HIPPOPHAE RHAMNOIDES*)**

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Several *in vitro* regeneration methods were established for seabuckthorn (*H. r. ssp rhamnoides* x *mongolica* hybrid) cultivar Julia and its offspring. Leaf explants from juvenile and adult plants regenerated adventitious shoots at high frequency when treated in appropriate salt medium together with plant growth regulators. These ex-

plants were also found to produce somatic embryos, and the embryos formed directly on explants and were found in different stages of development. Cotyledons and hypocotyls were, in general, not as responsive as leaf explants. It was possible to generate adventitious shoots from root systems of seedlings and at the basal end of individual shoots. Mineral concentration, carbon source and plant growth regulator interactions affected regeneration and growth. Methods developed here for juvenile and adult plants will be significant for rapid clonal mass propagation and breeding programs.

Key words: adult, adventitious shoot regeneration, juvenile, plant growth regulators, seabuckthorn, somatic embryos

МЕТОДЫ РАЗМНОЖЕНИЯ ОБЛЕПИХИ (*HIPPORHAE RHAMNOIDES*) IN-VITRO

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Рассмотрены методы микроразмножения облепихи гибридов *H. r. ssp rhamnoides* x *H. r. ssp mongolica* в ювенильной и взрослой стадиях. Показана более высокая степень пролиферации адвентивных побегов при использовании в качестве экспланта листьев облепихи, по сравнению с использованием семядолей и гипокотыля. Предложены оптимальные составы питательных сред.

PROSPECTS FOR DEVELOPING INSTRUMENTATION FOR HORTICULTURE

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For the last 20 years in Russia, for various reasons, the development and production of measurement instrumentation (MI) for needs of agribusiness industry have been distinctly cut down. We connect the prospects for developing home instrument-making for agriculture, including horticulture, with the development of certain lines.

First, the existing situation can be improved by orientation to development of home-produced MI based on new efficient principles of measuring. The principle of measuring is realized in an analog part of an instrument – in a transducer.

As an example of realization of this line, we can present the device “Dina” developed at SibFTI together with Lisavenko Institute, and intended for measuring tearaway force of a berry from its stem. The tearaway force of sea buckthorn berries from a branch is one of the most important characteristics taken into consideration when developing new varieties of this unique crop. This characteristic to a considerable extent influences the labour productivity when harvesting, and is used as input data when developing berry-harvesting machines and mechanisms. The device “Dina” in addition to the original tearaway force transducer contains an electronic unit, a digital readout and control elements. A peak detector is included in the electronic unit, and owing to it, after the action of force decreases or ends, the maximal value of force, which is the force at the moment of tearing a berry away, is reflected on the digital readout. The work of the device consists in fixing the maximal value of force in axial direction applied to capture of a berry. In order to do this, it is necessary, before applying force, to set the device into the starting position

by means of a special control button, and after the action of force ends, to read data from the digital readout.

The second line of developing competitive MI is connected with realization of patented decisions on the basis of foreign electronic components. The automatic regulator “Tuman-6” can be an example of such a development, and is intended for controlling modes of lighting, watering, heating, and other processes needed to be controlled in the course of time. This device came into wide use when propagating fruit crops by cuttings. The automatic regulator is protected by certain patents. It differs from analogs in simplicity of setting predetermined parameters; in a possibility to implement operating modes all the day round; in keeping capacity for work when power supply is turned off; in protecting predetermined parameters under power faults, and etc.

The third line of developing MI is based on improvement and modification of foreign-produced MI for horticulture industry. An example of realizing such an approach is the indicator “Krona-1” for determining lengths of plants, branches and shoots of fruit and berry crops.

The fourth line is the development of special purpose MI, which are not produced anywhere in the world. The representative of this line is the device “PLODTEST-1” to measure berry-crushing force. This device can be used when carrying out the breeding work, and when controlling the quality of fruit-and-berry products under storing and transporting. The device enables determining berry-crushing force from 0 to 5.4 kgs. Its features are a possibility to crush berries with easy-to-use built-in screw-down mechanism; a possibility to compensate the weight of screw-down mechanism; a possibility to calculate an average value of up to 10 readings; automatic power disconnection in 3 minutes, and etc.

Key words: instrumentation, horticulture, tearaway force of a berry, berry-crushing force, plant length indicator, automatic regulator of watering.

ПЕРСПЕКТИВЫ РАЗРАБОТОК СРЕДСТВ ИЗМЕРЕНИЙ В САДОВОДСТВЕ

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Представлены разработки Сибирского физико-технологического института при производстве средств измерений для садоводства. Показаны четыре направления реализации новых идей. Приведены примеры внедрения новых средств измерений в производстве.

CHEMISTRY

БИОХИМИЯ

ALKYL DERIVATIVES OF SUGARS AND SUGAR ALCOHOLS IN SEA BUCKTHORN (*HIPPOPHAE RHAMNOIDES*) BERRIES

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The major sugars of sea buckthorn berries are glucose and fructose, which vary widely according to genetic and environmental factors. Sucrose exist in trace amount in berries of some origins. In addition, some neutral polyols, their alkyl derivatives as well as alkyl glycosides have been recognized in varying quantities. Most of these compounds exist in trace amount only.

Composition and content of compounds related to simple sugars and polyols were analyzed in the juice of sea buckthorn (*Hippophaë rhamnoides* L.) ssp. *sinensis*, ssp. *rhamnoides* and ssp. *mongolica*. The berry samples were randomly selected for chemical analyses and the results do not necessarily represent average composition of the three subspecies. The berries were hand-picked and frozen, and the juice was extracted by pressing after gentle thawing. The “sugar” fraction was isolated by solid phase extraction on an Isolute CH and SAX column. TMS derivatives of the compounds were analyzed by GC-FID and GC-MS (EI, 70 eV) and the results were compared with literature information and reference compounds when available. A reference compound ethyl β -D-glucoside was synthesized. The two major unknown compounds were isolated by HPLC and the fractions collected were subjected to GC-MS (EI, 70 eV, TIM, SIM), HPLC-

ELSD, ^1H and ^{13}C NMR (2D) analyses and optical activity measurements, when needed.

The major identified compound in ssp. *sinensis* berries was (-)-2-O-methyl-L-*chiro*-inositol [(-)-L-quebrachitol], which was less abundant in the subspecies *ramnoides* and *mongolica*. In the two latter subspecies, instead, ethyl β -D-glucopyranoside was a dominant compound, whereas in some samples of ssp. *sinensis* the compound hardly existed. Another methylinositol, evidently methyl-*myo*-inositol, *chiro*-inositol and *myo*-inositol were found in trace amounts. The compounds may be of special importance for plants in drought areas. Also their effects on the sensory properties and health effects of the berries should be taken into account.

Key words: Ethyl β -D-glucopyranoside, *Hippophaë rhamnoides*, (-)-2-O-methyl-L-*chiro*-inositol, sea buckthorn berries, sugar alcohols.

АЛКИЛ ПРОИЗВОДНЫЕ САХАРОВ И СПИРТЫ В ПЛОДАХ ОБЛЕПИХИ (HIPPOPHAË RHAMNOIDES)

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Основные сахара облепихи – глюкоза и фруктоза, которые меняются в зависимости от генетических факторов и факторов окружающей среды. Кроме того, некоторые нейтральные полиолы, их алкиловые производные, как и алкиловые гликозиды имеются в различных количествах.

Состав и содержание компонентов, относящихся к простым сахарам и полиолам, анализировался в облепиховом соке трех подвидов облепихи. Образцы ягод были отобраны для химического анализа. Ягоды собирались вручную и замораживались – сок экстрагировался прессованием и мягким размораживанием.

Основным компонентом в ягодах *ssp sinensis* был (-)-2-0 – метил-L-хиро-инозитол t(-)-л-квебрахитол, который отмечен в меньших количествах в подвидах *rhamnoides* и *mongolica*. В последних двух подвидах преобладающим компонентом был этил β-D-глюкопиранозид. Исследуемые компоненты играют важную роль в процессах адаптации к засухам, а также оказывает влияние на органолептические свойства и оздоровительный эффект.

**L-QUEBRACHITOL IN SEA BUCKTHORN
(HIPPOPHAË RHAMNOIDES) BERRIES
OF DIFFERENT ORIGINS AND HARVESTING DATES**

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Sea buckthorn (*Hippophaë rhamnoides*) berries are known to have a wide range of beneficial effects on human health. These widely proven physiological effects are partially ascribed to the commonly known components such as fatty acids, vitamins, flavonoids, and plant sterols of the berries. Much work remains to be done to identify new bioactive compounds of the berries and to investigate their effecting mechanisms. A sugar alcohol (-)-2-O-methyl-L-*chiro*-inositol [(-)-L-quebrachitol] has been reported in sea buckthorn berries recently. The presence and the content of this compound may be an indicator of some important aspects of plant physiology and may have significant impact on the health effects of sea buckthorn berries.

The aim of the present study was to compare the content of L-quebrachitol in sea buckthorn berries of different origins and to investigate the effects of harvesting date on the content of the compound in the berries. Wild and cultivated berries of ssp. *sinensis*, ssp. *rhamnoides* and ssp. *mongolica* were harvested in China, Finland and Russia in four consecutive years. The sugar fraction was isolated with a solid phase extraction method from freshly pressed berry juice. Trimethylsilyl (TMS) derivatives of the sugars and sugar alcohols were prepared and analysed quantitatively by gas chromatography (GC-FID). The content of L-quebrachitol varied widely from 0.1% to 1.6% in the juice depending on the different origins and harvesting dates of the berries. The levels in the wild Chinese berries (average content in berry juice, 0.8%) were significantly higher than those found in wild and cultivated berries from Finland (average content in berry juice, 0.3%) and Russia (average content in berry juice, 0.2%) ($P < 0.01$). During the harvesting period from late August to late November, the content of L-quebrachitol showed an increasing trend in the berries of wild ssp. *sinensis* from China and the cultivars of ssp. *rhamnoides* from Finland. Considerable annual variations were recognized in the berries of the same origins. The accumulation of this compound in the berries and especially the high content found in Chinese berries may have been resulted from the activation of biochemical pathways in the plant in adaptation to limited supply of water in the growth environment. Based on the widely shown health effects of inositols and methylinositols, L-quebrachitol is likely to be an important bioactive compound in sea buckthorn berries. Further studies are essential in order to understand the physiological effects of this compound as well as the interactions and synergies between this compound and other components in the berries.

Keywords: harvesting date, *Hippophaë rhamnoides*, L-quebrachitol, methylinositol, (-)-2-O-methyl-L-*chiro*-inositol, origin, sea buckthorn.

**L-КВЕБРОХИТОЛ В ПЛОДАХ ОБЛЕПИХИ
(*HIPPORHAE RHAMNOIDES*)
РАЗЛИЧНОГО ПРОИСХОЖДЕНИЯ И СРОКОВ УБОРКИ**

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Изучено содержания L-квеброхитола в плодах облепихи подвидов *sinensis*, *rhamnoides*, *mongolica*, собранных в Китае, Финляндии и России. Установлены различия в накоплении L-квеброхитола в зависимости от происхождения и периода уборки. Установлено, что накопление исследуемого вещества в китайских образцах значительно превышает уровень финских и российских аналогов.

**STUDY ON OPTIMIZATION
OF EXTRACTION TECHNIQUE
OF 5-HYDROXYTRYPTAMINE FROM SEABUCKTHORNS
BY RESPONSE SURFACE METHODOLOGY**

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RSM was used to optimize 5-hydroxytryptamine extraction process from sea buckthorn. Use Sea buckthorn fruit and twig residue which extract the juice and seeds as the raw material, on the basis of single factor experiments, selected levels and factors which was greater impact to 5-hydroxytryptamine extraction, according to the central composite design, three factors and three levels of response surface method (RSM) was used, yield as the reference indi-

cators, and 5-hydroxytryptamine optimum extraction parameters: raw material particle size: 3.1mm, extraction number: 3 times, extraction time: 1.4h. Under these conditions, the yield was 0.8712.

Key words: 5-hydroxytryptamine; Response Surface Methodology; seabuckthorn.

ОПТИМИЗАЦИЯ ЭКСТРАКЦИИ 5-ГИДРОКСИТЕТРОМИНА ИЗ ОБЛЕПИХИ МЕТОДОМ ПОВЕРХНОСТНОГО ОТКЛИКА

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Изучено влияние метода поверхностного отклика в различных вариантах на оптимизацию процесса экстракции 5-гидрокситетромина из облепихи.

COMPARISON OF THE ACTIVE COMPONENTS BETWEEN THE PEEL OIL AND THE SEED OIL OF SEABUCKTHORN

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General Analysis and comparison showed that the oil content of sea buckthorn peel is very higher than that of sea buckthorn seed. The contents of carotenoids and vitamin E from sea buckthorn peel oil are 240% and 31% higher than that of the seed oil respectively and also oleic acid, linoleic acid, linolenic acid of unsaturated fatty acids are about 3 times of the seed oil in biochemical composition.

Key words: sea buckthorn peel oil, sea buckthorn seed oil, biochemical composition, fatty acid composition

СРАВНИТЕЛЬНАЯ ОЦЕНКА МАСЛА, ПОЛУЧЕННОГО ИЗ КОЖИЦЫ И СЕМЯН ОБЛЕПИХИ

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Общий анализ и сравнение показали, что содержание масла в кожице облепихи намного выше, чем в семенах. Содержание каротиноидов и витамина Е в масле, полученном из кожицы облепихи в 2,4 раза, а содержание олеиновой, ленолевой, линоленовой кислот в 3,0 раза выше, чем в масле, полученном из семян.

A COMPARISON STUDY ON SEABUCKTHORN OIL AND OTHER EDIBLE OILS IN THEIR MAIN COMPONENTS

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With rich nutritional and bio-active substances seabuckthorn oil is considered as one of most valuable part. It is necessary to determine why seabuckthorn oil is an unique and better than other nutritional oils. A study on comparison analysis between seabuckthorn oil and oils like olive, wheat embryo, maize and evening primrose has been carried out. The analysis results have shown that seabuckthorn oil and other edible oils are rich in unsaturated acids. The contents of unsaturated acids rank from 84% to 90%. The contents of vitamin E (206-360 mg/100g) and carotenoids (230-377 mg/100g) in seabuckthorn oil are much higher that any other edible oils. The results of the analysis suggested that seabuckthorn oil is valuable nutritional oil that implies it should be in higher price in market.

Key words: seabuckthorn oil, olive, wheat embryo, maize, evening primrose, nutritional component.

СРАВНИТЕЛЬНОЕ ИЗУЧЕНИЕ ОБЛЕПИХОВОГО И ДРУГИХ МАСЕЛ ПО ИХ ОСНОВНЫМ ПАРАМЕТРАМ

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Приведен сравнительный анализ биохимического состава облепихового, оливкового, кукурузного масла, а также масла пшеничного зародыша и др. Анализ показал, что исследуемые масла богаты ненасыщенными кислотами, содержание которых колеблется от 84 до 90%. В то же время содержание витамина Е и каротиноидов в облепиховом масле существенно превышает показатели других масел.

SOME RESULTS ON THE CONTENTS OF SEABUCKTHORN PLANTED IN MONGOLIA

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During the process of economic development, people tend to care more about their health as their income increases. Consequently, their demand for healthy food being produced from various types of plants (i.e., pure ecological products) increases. In such countries, fruits are everyday food rather than being considered as luxury consumption previously. Across the world, researchers produce new sorts of fruits which are more efficient and productive than the existing ones. One of such fruits is seabuckthorn.

Our project intends to calculate the quantities of biochemical elements (such as protein, acid, vitamin C, sugar, vitamin E) of various sorts of seabuckthorn. This paper presents the findings of the study based on the sorts sampled from TES-1, TES-2, Bukhmurun, Selenge, Davst, Shaamar and Zuunbyren, Chuiskaya. We find that, on average, these sorts contain 2.2-4.0 mg/% sugar, 2.2-3.2 mg/%

acid, 2.1-5.21 mg/% beta-carotene, 17-22.3 mg/% токоферол (vitamin E), 17.0-18.6 mg/% dry substance, 0.59-0.8mg/% ash and 10.8-29.7 mg/% carotenes. Although seabuckthorn has been intensively studied, it is not necessary to view that its quantities and contents of biochemical active substances, behaviour, and physiology and biochemical characteristics have been completely analyzed.

РЕЗУЛЬТАТЫ ИЗУЧЕНИЯ БИОХИМИЧЕСКОГО СОСТАВА ОБЛЕПИХИ, ВОЗДЕЛЫВАЕМОЙ В МОНГОЛИИ

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Представлены результаты биохимического анализа ряда монгольских и российских сортообразцов при возделывании их в условиях Монголии.

THE EFFECT OF DIFFERENT ORGANIC FARMING METHODS ON THE PHENOLIC COMPOSITION OF SEA BUCKTHORN BERRIES

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The effects of different organic cultivation methods on the berry phenolics of two Finnish sea buckthorn (*Hippophae rhamnoides* L. ssp. *rhamnoides*) cultivars, 'Terhi' and 'Tytti', were studied in an experimental field at coastal area in Merikarvia, western Finland.

Cultivation methods included different fertilizers (designed for organic cultivation), mulches (organic and plastic) and land contours (flat land vs. ridged beds). Two experiments were conducted: The first, a fertilization experiment, allowed the estimation of the effects of cultivar, fertilizer, land contour and all their interactions. The second experiment, a mulch experiment, allowed the estimation of the effects of mulch, land contours and their interactions for the cultivar 'Tytti'. Berry phenolics were analyzed by HPLC with UV-detection. The results suggest there are significant differences between the cultivars and cultivation methods. The concentrations of quercetin derivatives 1-3, isorhamnetin 3,7-diglucoside, quercetin-3-glucoside-7-rhamnoside, quercetin 3-glucoside, isorhamnetin 3-glucoside and flavonoid derivative 3 were higher in 'Tytti' than in 'Terhi', while concentrations of isorhamnetin-glucoside 2 and 3 were higher in 'Terhi' than in 'Tytti'. Flat land increased the concentrations of isorhamnetin 3,7-diglucoside, isorhamnetin-glucoside 1, quercetin derivatives 2, 4 and condensed tannins. Mulch did not have any significant effect on the concentrations of phenolic compounds. These results indicate that the phenolic accumulation in berries of studied sea buckthorn cultivars seems to be mainly dependend on cultivar selection and soil structure.

Key words: *Hippophae rhamnoides*; organic farming; phenolic compound; berry; cultivar; fertilizer; mulch; land contour

ВЛИЯНИЕ РАЗЛИЧНЫХ МЕТОДОВ ОРГАНИЧЕСКОГО ЗЕМЛЕДЕЛИЯ НА ФЕНОЛЬНЫЙ СОСТАВ ПЛОДОВ ОБЛЕПИХИ

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Изучено влияние различных органических методов возделывания на фенольный состав ягод двух финских сортов облепихи Тери и Титти в условиях западного побережья Финляндии.

Исследованы различные удобрения, мульчирующие субстанции, условия рельефа. Результаты показали, что накопление фенольных веществ в плодах в основном зависит от сорта и структуры почвы.

LIPIDS IN FRUIT PULP AND SEED OF CULTIVATED AND WILD SEABUCKTHORN (HIPPOPHAE RHAMNOIDES L.) ON THE EAST COAST OF SWEDEN

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Seabuckthorn berries contain high levels of lipids with beneficial bioactive effects on humans. The aims of this study were to investigate the composition of fatty acids and tocopherols in fruit pulp and seeds of seabuckthorn in Sweden and to compare three seabuckthorn cultivars with wild seabuckthorn with regards to contents of these compounds. Berries from the cultivars were Augustinka (a clone originating from Lithuania), Ljublitelskaya (a hybrid between an Altai clone and a Baltic clone) and Podaruk Sadu (a Russian clone) were obtained from a cultivation at Gräsö, Uppland, Sweden. The wild seabuckthorn samples were directly collected from natural populations occurring along the Uppland coast, Sweden, on the shore of the Gulf of Bothnia. Samples were also harvested from seedling-derived plants earlier collected from the same area and cultivated at SLU, Uppsala. The contents and composition of fatty acids and tocopherols were analysed using gas chromatography and high pressure liquid chromatography, respectively. We found that the total lipid content ranged between 2 to 5 % in pulp and between 3 to 8 % in seeds. The most abundant fatty acids in the pulp of seabuckthorn were 16:0, 16:1n-7, 18:1n-9, 18:1n-7 and 18:2n-6. The most abun-

dant fatty acids in the seeds of seabuckthorn were 18:1n-9, 18:2n-6 and 18:3n-3. In the pulp the composition of fatty acids varied among all samples. The improved cultivars had higher content of the 18:2n-6 compared to the wild seabuckthorn. The content of 18:1n-9 was several-fold higher in the wild seabuckthorn compared to the seabuckthorn cultivars. Overall, there was low variation for all fatty acids in seeds among all samples. Among the tocopherols, α -tocopherol was the most abundant in the pulp and both α - and γ -tocopherols dominated in the seed. Again, variation among samples in the content of α -tocopherol was bigger in the pulp compared to in the seed. This study showed big variation among wild and cultivated wild seabuckthorn and improved cultivars in the amounts of several fatty acids with interesting bioactive functions in humans. It was possible to identify genotypes having high level of bioactive compounds as possible sources in future plant breeding.

Key words: cultivars, fatty acids, fruit pulp, seabuckthorn (*Hippophae rhamnoides* L.), seeds, sterols, tocopherols, wild seabuckthorn, cultivated wild seabuckthorn.

ЛИПИДЫ ПЛОДОВОЙ МЯКОТИ И СЕМЯН ДИКОЙ И КУЛЬТУРНОЙ ОБЛЕПИХИ НА ВОСТОЧНОМ ПОБЕРЕЖЬЕ ШВЕЦИИ

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Проведен сравнительный анализ жирных кислот и токоферолов в мякоти плода, а также семенах диких и культурных форм облепихи в условиях восточного побережья Швеции. Установлены существенные различия между исследуемыми вариантами и предложено использование полученных знаний при идентификации генотипов.

THE EFFECT OF FORMS OF POLLINATORS ON THE OIL CONTENT AND HYDRATION DEGREE OF SEA-BUCKTHORN FRUIT MESOCARP

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Sea-buckthorn oil extracted from the fruit mesocarp is a valuable medicine with its ever-increasing demand. Therefore, the selection work aimed at increasing the oil content of this part of fruit does not still lose its urgency. As sea-buckthorn is a dioecious plant, one of the methods for the solution of this problem is to select forms of pollinators, which genotype may favour the growth of the oil content in its fruit. The oil-forming process in the fruit mesocarp of some plants (sea-buckthorn, olive, avocado, magnolia-vine and any others) occurs at high humidity, therefore, there was determined both the pericarp oil content and also the hydration dynamics of this part of fruit.

The subjects of research were ripening and ripe sea-buckthorn fruits resulted from crossing pistillate plants T-50 (selection by the MSU) with seedling pollen K-24 obtained from seeds K-24 treated by X-ray radiation of 50 0000 R. A number of varietal species were selected in course of that crossing process. Two of them (Vasilisa and Duet) were V.A. Fefelov's selection varieties and one of them (ELS 8/93) was an elite form. As control specimens served pistillate plant fruits T-50 resulted from the random pollination.

The obtained results enabled to determine that the oil content of the ripe fruit hypanthium for studied hybrids was comparable and reached 4 to 4.3 mass %. One may note only a slight superiority of Duet with its oil content reaching 4.3 mass %. The other two varieties (ELS 8/93 and Vasilisa) were slightly inferior to it by the said factor. They hardly differ from each other and reached 4.0 and 4.1 mass %, respectively. The oil content of control specimens (T-50) was by 1.4 to 1.5 times inferior to the above varieties and was 2.8 to 2.9 mass %.

The oil was accumulated at high hydration of the fruit mesocarp with its level increasing at the maximum rate (0.2 to 0.3% per day⁻¹)

at the early stages of the fruit development (from 62 to 74 days after pollination) followed by the increase in humidity of tissues of that organ up to the botanic ripeness stage (109 days after pollination). Vasilisa was characterized by the highest tissue hydration (90%). Elite form ELS 8/93 and Duet were slightly inferior to it. Control specimen T-50 predominated over all the varieties and forms in that factor by reaching its humidity up to 91.6%. When fruits reached their ripeness (144 days after pollination) the hydration of all sorts and forms was reduced by 1-2%. It was comparable and reached 88-89% while control specimens reached 90%.

Thus, the hydration level of the hypanthium for all studied specimens reached a high degree (over 80%) at the early stages of the fruit development (by the 62nd day after pollination). Therefore, the process of the active oil accumulation, which had begun from the 82nd day after pollination, always took place at high humidity of 85 to 90%.

Key words: sea-buckthorn fruits, oil content, hydration, genotype

ВЛИЯНИЕ ФОРМ ОПЫЛИТЕЛЕЙ НА СОДЕРЖАНИЕ МАСЛА И СТЕПЕНЬ ГИДРАТАЦИИ МЕЗОКАРПИЯ ПЛОДОВ ОБЛЕПИХИ

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Показано значение опылителей и степени гидратации перикарпия на процессы накопления масла в мезокарпии плодов облепихи. Проведено сравнительное изучение ряда сортообразцов по изучаемым признакам. Показано, что накопления масла всегда происходит в условиях высокой влажности плодов.

**A FORM AND BIOCHEMICAL DIVERSITY
OF SEABUCKTHORN IN SHEKI-ZAGATALA ZONE
OF AZERBAIJAN**

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Sheki-Zagatala zone of Azerbaijan is one of areas of natural growth of seabuckthorn (*Hippophae rhamnoides L.*) on the Big Caucasus. It is distributed here on numerous river valleys and on pebble channels, basically on well shined places on the middle current of the rivers and differs by great variety.

In 2008 we had been lead inspection of natural thickets of seabuckthorn in Sheki, Gakh, Zagatala and Balaken districts. The seabuckthorn here meet basically in valleys of the rivers Ayrichay, Shinchay, Kishchay, Agchay, Gurumushchay, Mukhakhchay, Katekhchay and Mazimchay. The most significant thickets are in bottomland of the rivers Kishchay and Shinchay. The basic vital form of seabuckthorn is the bush in height of 2.5-3.5 m, sometimes 4.5 m, here treelike forms do not meet.

In a result of studying of morphological variety of seabuckthorn individuals have been specified 12 forms. It is established that these forms essentially differ among themselves on average height of bushes, the sizes of leaves, forms, by colour and size of fruits and seeds, length of a fruit steam, a prickly degree of bushes, length of a prickles. The form of fruits vary from circular up to ovate-oblong, painting from yellow up to orange, but prevail the oval forms of the average sizes with golden-yellow painting. In natural boundary of Marhal, bottomland of the Mukhakh and Kish rivers meet seabuckthorn with orange fruits. To the majority of forms is peculiar dry abruption of fruits with an average degree of development of a prickle. The forms of 4, 7 and 9 differs from others by a high degree of fructification (on generative runaway in length of 10 cm are included about 120-130 fruits).

Results of chemical analyses of fruits of the selected forms testify to the big variability of the contents in them of carotin, vitamin C and E, phenolic compounds. On the coil percentage and acidity the forms are differ insignificantly. In the selected forms the content of vitamin C changes from 87.5 up to 235.7 mg%, carotinoids – 6.2-12.4 mg%, flavonoids – 420.3-674.4 mg%, catechins – 78.5-142.5 mg%, fat oils - 3.40-5.05%, dry substances – 18.0-22.3, acidity of 2.54-3.40% from weight of crude fruits. The form No 4 on the high contents of vitamin C, forms No 3 and No 7 - on the high contents of carotinods, forms No 2-4 - on the high contents of flavonoids, forms No 4 and No 6 - on the high contents of catechins differ from other forms. It is established that fine fruits contain more than dry substances and vitamin C.

Thus the selected forms are characterized by valuable biological and chemical parameters and it testify to perspectives of their use for introduction and in selection.

Key words: seabuckthorn, distribution, form diversity, biochemical diversity, chemical composition.

ФОРМООБРАЗОВАНИЕ И БИОХИМИЧЕСКОЕ РАЗНООБРАЗИЕ ОБЛЕПИХИ В ЗОНЕ ШЕКИ-ЗАГАТАЛА АЗЕРБАЙДЖАНА

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В результате обследования морфологического разнообразия облепихи в районе Шеки-Загатала Азербайджана – зоны естественного произрастания облепихи на Кавказе – выделено 12 различных экологических форм. Установлено их различие между собой по высоте куста, размеру листьев, форме, цвету и размеру плодов.

Результаты химического анализа плодов отборных форм свидетельствуют о большом варьировании в них каротина, витаминов С и Е, фенольных компонентов, что говорит о реальных перспективах их применения при интродукции и в селекции.

FAST FROZEN FRUITS OF SEA BUCKTHORN, THEIR BIOCHEMICAL COMPOSITION AND OTHER INDEXES

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In Nizhny Novgorod State Agricultural Academy there were investigated fresh and frozen fruits of seabuckthorn from nine cultivars: Dar Kazakovu, Duet, Duimovochka, Nadezhda, Nizhegorodskii Suvenir and elite forms 21/90, 35/90, 52/90.

Fruits were frozen in freezing chambers at a temperature of – 20°C being placed in densely closed polyethylene bags. The production was stored in the same chambers. Fruits were analyzed before freezing and in 9 months of storage.

When frozen, fruits were found to increase in dry substances by 0.1-2.3% and in sugar content – by 0.1-0.6% comparing with fresh ones. Increased acidity of frozen fruits was noticed in some cultivars while others have the index decreased.

Vitamin losses in frozen fruits were small. Carotene was kept better than vitamin C. Content of carotene in frozen production depended on cultivar. The most quantity – 212 ppm, 218 ppm, 227 ppm – was noticed in fruits of Nizhegorodskii Suvenir cultivar and 35/90, 52/90 elite forms. Duimovochka and Dar Kazakovu cultivars were distinguished for their good vitamin C retention.

The second aim of the work is to select seabuckthorn cultivars giving maximal quantity of good quality juice. There were calculated volumes of juice produced from fresh and frozen fruits and juice loss during unfreezing.

Fresh fruits gave more juice comparing with frozen – by 5-19%. The maximal quantity of fresh fruit juice was obtained from Prevoskhodnaya cutivar – 84.3% and from 35/90 – 82.2%.

Some cultivars had their fruits to tear off without fruit stems. When unfrozen the fruits exuded juice. This juice was considered as lost. Investigation showed fruit stems of Nadezhda and Nizhe-

gorodskii Suvenir cultivars not to tear off from pulp. So there was no loss of juice from unfreezing fruits. Fruits of those cultivars could be recommended for production of natural juice after freezing.

Processed juices kept colour and aroma of fresh fruits.

БЫСТРОЗАМОРОЖЕННЫЕ ПЛОДЫ ОБЛЕПИХИ, ИХ БИОХИМИЧЕСКИЙ СОСТАВ И ДРУГИЕ ПОКАЗАТЕЛИ

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Проведено биохимическое изучение свежих и замороженных плодов облепихи после 9 месяцев хранения. Установлены изменения биохимического состава в процессе хранения. Отмечено варьирование сохранности различных групп витаминов.

Определен выход сока из свежих и замороженных плодов различных сортов облепихи, а также потери сока в процессе дефростации.

ON HYDROLYZING TANNINS FROM SEABUCKTHORN LEAVES

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Seabuckthorn (*Hippophae rhamnoides* L.) is the popular medicinal plant of the flora of Russian Federation, which is used since old times in traditional medicine and dietetics (juices and the fatty oil from the fruits, and extracts from leaves). Purified polyphenol frac-

tion was isolated from the leaves, containing monomeric hydrolyzing gallo-ellagi-tannins (preferably strictinin, isostrictinin, casuarinin, pedunculagin and stachyurin according to the NMR spectra), possessing a high antiviral activity in respect of various pathogenic viruses (Influenza, Herpes, cytomegaloviruses, HIV etc.). The specific biological activity of the drug is determined as the synergetic action of antiviral polyphenols on various viral strains via inhibiting neuraminidase activity and producing interferon induction action. The drug has also exhibited a potent antibacterial activity. The maximal tannins contents in Seabuckthorn leaves were found at the period of maximal accumulation of biologically active substances, the best time of purchase being July (over 20%). Additional bioactive component of the polyphenol fraction – cyclic polyol quebrachitol (2-O-methyl-(-)-inositol) has been recently found by (Nobre et al., 2006; de Olinda et al., 2003) as the antioxidant and cytoprotective agent. Quebrachitol has also shown to be the gastro-protector by the mechanisms that involve endogenous, nitric oxide release, and the activation of K⁺ATP channels. The maximum of quebrachitol accumulation in Seabuckthorn leaves was found in September – October (up to 12 – 14.4%). The antiviral polyphenols from Seabuckthorn are inclined to form with quebrachitol stable supra-molecular complexes. The antiviral drug, containing purified polyphenol fraction from Seabuckthorn, is to date produced at the commercial scale in Russia at the name Hiporamin. Crude drug from the wild forms of *H. rhamnoides* or their breeding varieties, as well as green herbaceous shoots are used for the production of the drug.

The NMR method was used for tannins determination (total tannin contents and their composition) in the tannin fraction (after purification from flavonoids). Their NMR spectra contain signals of tannins protons only in aromatic area. This fraction was also shown to contain carbohydrates and cyclic polyol quebrachitol. Comparative tannins content in the fraction was calculated on the basic tannin casuarinin, using integral of aromatic protons (M. m. 936.65) using integrals value of aromatic signals at (I_t, 6.2 – 7.3 ppm, 5H) and at (I_c, 3.3 – 4.3 ppm) for quebrachitol and carbohydrates (M. m. 180, 6H). Admixture of mineral substances in the drug comes to 4%.

Calculations were carried out according to the formula: $X_t(\%) = 100/[0.19*(I_c/I_t) + 1]$, where the index 0.19 = $M_{casuarinin}/M_{glucosa}$

The 2H singlets of aromatic protons of bonded gallic acids at 7.0 – 7.21 ppm, and of the hexa-hydroxy-diphenic and valoneic acids fragments at 6.35 – 7.05 ppm in the NMR spectra can be clearly seen. Signals of protons of free galic acid were not found in the spectrum. Presence of two H₁ signals of glucose in the NMR spectrum of pedunculagin at 6.3 ppm testifies to existence of its two conformations (α,β). Total tannin contents determined on 10 series of the drug were 62 – 75.9 %. The NMR data are very similar to that produced by the UV spectroscopy method (62.5 – 74.0 %). Quebrachitol contents were found to be in the range 10 – 15 %.

Key-words: Seabuckthorn (*Hippophae rhamnoides* L.), tannins, NMR-method of analysis.

ГИДРОЛИЗАЦИЯ ТАНИНОВ ИЗ ЛИСТЬЕВ ОБЛЕПИХИ

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Определены периоды максимального накопления различных полифенольных соединений в листьях облепихи. Установлены количественные значения танинов.

BIOCHEMICAL COMPOSITION OF ALTAI SEA-BUCKTHORN VARIETIES

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Unique properties of sea-buckthorn are stipulated a long with other characters, by rare riches and the variety of chemical composition of fruits. Nowadays, food and medicinal prophylactic value of sea-buckthorn are indisputable. The crop takes an important place in

the system of preserving and improvement of man's health in stress conditions of natural medium. Wide polymorphism in chemical composition of fruits stipulates the actuality of sea-buckthorn investigations, gives wide possibilities for breeding, development of valuable for our region assortment of the crop.

Sea-buckthorn is one of the leading crops at M.A. Lisavenko RIHS. The majority of the investigated varieties and hybrids, as a rule, are characterized by middle and high levels of accumulation of chemical substances, although vibrations in relation to biochemical composition of fruits are significant. So, the content of dry soluble substances varies from 5 up to 15%, sugars – from 2 up to 12%, organic acids – from 0.8 up to 4%, vitamin C – from 25 up to 200 mg/100g and higher, oil – from 3 up to 9%, carotenoids – from 6 up to 52 mg/100g, tocopherols – from 6 up to 65 mg/100g. Wide application of variety-specimens with low acidity of fruits and high content of sugars in a breeding process gave us a possibility to select forms, capable to accumulate in fruits up to 12.5% of sugars (1186-85-3, 1186-84-2, 74-78-1, 1137-81-6 and others). The sources of high content of sugars are such sea-buckthorn varieties: Elizaveta, Tenga, Chulishmanka, homeostatic in relation to the given character. Acidity reduction of hybrids 39-40-1, 1299-83-5, 1460-90-1 and others achieved the minimum level – 0.7%. At present desert forms with good harmonic taste of berries have been selected at RIHS. They are used for fresh consumption and making of sea-buckthorn processing products without sugar, which are characterized by high indices of sugar-acidity index, the meanings of which in some variety-specimens achieve 12 (779-81-6, 39-40-1 and others). The above-mentioned sea-buckthorn varieties have a good taste of fruits, as well as the varieties Altaiskaya, Essel, hybrid forms 91-81-2, 45-15-13, 884-76-4, 4-93-7, 1131-86-1, 278-90-2, 1237-86-4 and others.

The development of the varieties with high content of biologically active substances in fruits is the priority direction in sea-buckthorn breeding. The varieties Tenga, Altaiskaya, Elizaveta, Ulala, Chechek, Drugina, Chulishmanka are the sources of high content of vitamin C. The following forms, capable to accumulate more than 200 mg/100g of vitamin C in fruits, were found out: 66-00-1, 664-00-1, 266-74-1, 136-84-3, 105-90-1, 980-78-7, 1184-83-1. Hy-

brids 1130-85-1, 87-70-14 were distinguished by maximum content of carotenoids. Forms 721-93-4, 45-15-2, 266-74-1, 535-73-2 contain more than 40 mg/100g of carotenoids, 779-81-5, 1184-83-1, 127-00-1, 165-81-1, 1471-81-1, 721-15-2, 87-93-2 and others – 30-40 mg/100g. 30% of the varieties and hybrids of altaiskaya sea-buckthorn has oil content in fruits equal to 7%. By present, we developed the variety-specimens with high content of oil, corresponding indices of which achieve 8% and more – Altaiskaya, Chulishmanka, 135-90-1, 1267-84-2, 579-73-1, 1349-84-3, 30-61-1487 and others. High level of vitamin E in fruits was marked in varieties Panteleevskaya, Chuis-kaya, Tenga and Jivko.

Biochemical variety-studying of sea-buckthorn gave us a possibility to select the varieties and hybrids, which are the sources not only of separate, but the entire complex of valuable biochemical characters – Elizaveta, Tenga, Chulishmanka, Ulala, Altaiskaya, 74-78-1, 1137-81-6, 278-90-1, 91-81-2, 957-82-6 and 1237-86-4.

Key words: chemical composition, dry soluble substances, sugars, acids, vitamin C, oil, carotenoids, tocopherols.

БИОХИМИЧЕСКИЙ СОСТАВ АЛТАЙСКИХ СОРТООБРАЗЦОВ ОБЛЕПИХИ

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Приведены результаты исследования биохимического состава сортообразцов облепихи селекции НИИСС имени М.А. Лисавенко. Выделены лучшие формы по накоплению отдельных биологически активных соединений, а также комплекса веществ.

**TRANSCRIPTOMIC AND METABOLITE ANALYSES
OF SEA BUCKTHORN (*HIPPOPHAE RHAMNOIDES L.*)
CULTIVARS GROWN
IN CANADA**

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The functional food and nutraceutical market is growing rapidly in North America. Sea buckthorn has been used for several decades in Asia and Europe for medicinal and nutritional purposes, but this industry is new in North America. Sea buckthorn was imported into Canada from Russia primarily as an ornamental plant in the 1930s. The hardiness of the plant and its reported nutritional properties suggest that sea buckthorn cultivation can be developed into an economically viable natural health products industry in Canada. Fruits from several superior cultivars selected on the basis of fruit yield, fruit and seed characteristics, skin toughness, thorniness, growth habit and harvesting ease, from sea buckthorn planted in Saskatchewan, were collected in 2007, quick frozen in liquid nitrogen and stored at -40°C. Fruits of five cultivars collected in this trial are being analysed for content and composition of fatty acids, flavonoids and other bioactives. In addition, the berry transcriptome of one selected cultivar is being determined using high-throughput 454 sequencing. These results will be presented. It is expected the outcomes of these and other similar studies will aid in marker-assisted selection of superior cultivars in breeding programs, as well as in the identification of genes involved in the synthesis of useful phytochemicals.

Keywords: Seabuckthorn, nutraceuticals, NHPs, EST, phytochemicals, metabolites

ТРАНСКРИПТОМНЫЙ И МЕТАБОЛИТИЧЕСКИЙ АНАЛИЗ СОРТООБРАЗЦОВ ОБЛЕПИХИ, ПРОИЗРАСТАЮЩЕЙ В КАНАДЕ

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Представлены результаты изучения биохимического состава, а также транскриптомов плодов сортов облепихи в условиях Саскачевана, Канада.

BIOLOGICAL ACTIVE COMPONENTS OF *HIPPOPHAE RHAMNOIDES* SSP. *CAUCASICA* ROISS. OIL

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Carotinoids, tocopherols, unsaturated fatty acids, phospholipids, sterins, possessing antioxidant, anticancerogenic, antisterile, antisclerotic properties, are basic biologically active components of seabuckthorn oil. Continuing studying of the wild-growing seabuckthorn growing in Azerbaijan, investigated qualitative composition and quantitative contents of biologically active components of oil from the whole fruits, fruit pulp and seeds of seabuckthorn.

As a result of research it is established that the contents of carotinoids in fruits of seabuckthorn depending on growth condition and a phase of development changes from 5.2 up to 10.8 mg%, tocopherols - from 1.8 up to 7.2 mg%, oils - 3.1-4.7%. The contents of caroti-

noids in oil of fruit pulp 330.0, tocopherols - 248.0, in oil of seeds 56.0 and 102.0 mg%, accordingly.

The basic part of carotenoids is concentrated in a peel (62.5%) and pulp of fruits (25.8%). In composition of carotenoids from fruits is established presence α -, β - and γ -carotin, zeaxanthin, canthaxanthin, lycopine, cis-lycopine, lutein, taraxanthin and cryptoxanthin. The basic component of the carotenoid sum of fruits and fruit pulp is β -carotin, lycopine, zeaxanthin and oil of seeds β -carotin and zeaxanthine.

In the sum of tocopherols is identified α -, δ - and γ -tocopherols. The basic amount of the tocopherol sum makes α -tocopherol (65.4%) and δ -tocopherol (32.4% from a total sum). The same distributions are observed in oils of fruit pulp and seeds.

In oil of fruit pulp the following fatty acids are established: C_{14:0} (myristic) - 0.45; C_{16:0} (palmitic) - 35.40; C_{16:1} (palmiteoleic) - 52.00; C_{18:0} (stearic) - 0.85; C_{18:1} (oleic) - 10.70; C_{18:2} (lineolic) - 0.56; C_{18:3} (linolenic) - 0.31; in oil from seeds - C_{14:0} - 0.10; C_{16:0} - 9.63; C_{16:1} - 6.80; C_{18:0} - 1.55; C_{18:1} - 25.40; C_{18:2} - 35.80; C_{18:3} - 20.40% from weight of the fatty acids sum. Oil from seeds on comparison with oil of fruit pulp is rich with the factor of vitamin F (about 60% of the sum).

The content of phospholipids in oil from the whole fruits 1.05, from fruit pulp 1.18, from seeds 0.98; sterins: 1.41, 1.68; 1.34%, accordingly. The basic part phospholipids make lecithin and cephalin, and sterins - β -cytosterin.

Thus comparative research of composition of biologically active components of oils from the whole fruits, fruit pulp and seeds of seabuckthorn of Caucasian subspecies has shown that carotinoids basically are concentrated in oil of fruit pulp and is presented mainly by β -carotin and zeaxanthin. Tocopherols are evenly allocated in oil of fruit pulp and seeds. The basic part of the tocopherol sum make α - and δ -tocopherols; the factor of vitamin of group F is concentrated only in oil of seeds. Phospholipids and sterins in oil of fruit pulp and seeds are allocated evenly.

Keywords: seabuckthorn, oil, carotinoid, tocopherol, unsaturated fatty acids, sterin, phospholipids

**БИОЛОГИЧЕСКИ АКТИВНЫЕ КОМПОНЕНТЫ МАСЛА
ОБЛЕПИХИ ПОДВИДА HIPPOPHAE RHAMNOIDES SSP.
CAUCASICA ROISS.**

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Проведено комплексное изучение и представлены результаты биохимического состава масла, полученного из плодов и семян дикорастущей облепихи, произрастающей в Азербайджане.

**COMPARISON OF NUTRIENTS' DYNAMICS
IN EXOTIC FORM WITH LOCAL FORMS
OF SEABUCKTHORN (*HIPPOPHAE* L.)
IN DRY TEMPERATE HIMALAYAS**

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Studies on biochemical characterization and nutrients dynamics (fat, protein, fatty acids, vitamin C, carotenoids, vitamin E and flavonols) were carried out in the 2 elite forms (one each from Lahaul, a semi-arid region and Spiti, an arid region) of *Hippophae rhamnoides* ssp. *turkestanica* and one elite form of *H. salicifolia*, also from La-

haul and HI-1, an exotic form of *Hippophae rhamnoides*, all raised in 1995 at the farm area of Mountain Agriculture Research and Extension Centre of CSK Himachal Pradesh Agricultural University at Kukumseri (2730 m asl), in Lahaul valley a high altitude and semi-arid region of district Lahaul-Spiti of Himachal Pradesh, India.

Vitamin C generally decreased with fruit maturation. Vitamin C varied from 2305 to 4877 mg in Lahaul form. In Spiti form, it varied from 1444 to 1866 mg. In case of HI-1, its value varied from 2110 to 4423 mg. It varied from 24670 to 29840 mg/Kg in *H. salicifolia*. Vitamin C was maximum in *H. salicifolia* (27400 mg/Kg), followed by 3368.7 mg in Lahaul form, followed by 2982.7 mg in HI-1, and a minimum of 1658.7 mg in Spiti. It was found that fruit of HI-1 form had highest oil content (4.7%) on fresh weight basis, followed by Lahaul form (3%) and Spiti form (2.6%) and a minimum value in *H. salicifolia* (1.4%). In general, oil increased with maturation of fruits.

Palmitoleic acid was the major unsaturated fatty acid, being maximum in Lahaul form (46.4% of the total), which was significantly higher than other three forms, having almost the same value. Linoleic acid, an important fatty acid varied from a maximum of 15.0% of total fatty acids, in *H. salicifolia*, followed by pulp of HI-1 (10.1%) and a minimum of 6.4% in Spiti form. α -Linolenic acid, another very important unsaturated fatty acid, being also maximum in *H. salicifolia* (1.3%) is quite low in pulp of all forms. In seeds, Linoleic acid is the most abundant in the seeds of Lahaul (23.8%) and Spiti (39.8%) forms, much higher than HI-1 (11.8%) and *H. salicifolia* (3.7%). Similarly, α -Linolenic acid values were higher in Spiti form (25.4%) and Lahaul form (8.7%), as compared to other forms. Seeds of *H. salicifolia* were most rich in Palmitoleic acid (8.1%), value being lesser and same in Lahaul and HI-1 and lowest in Spiti form.

In Lahaul form, carotenoids varied from 118 to 171 mg/100g. In Spiti form, it varied from 108 to 248 mg. In HI-1 its value varied from 220.9 to 446.5 mg. In case of *H. salicifolia* the value of carotenoides varied from 7 to 20 mg/kg. Vitamin E was found maximum

during I collection in the pulp oil of *H. rhamnoides* from Spiti (3063 ppm), which decreased to 2237 ppm during II collection and a minimum of 1968 ppm during III collection. In Lahaul form, it increased from 2675 ppm during I collection and peaked to 2786 ppm during II collection and declined to 2553 ppm during III collection. Vitamin E in *H. salicifolia* decreased from a maximum of 1919 ppm during I collection to a minimum of 1290 ppm during III collection. A minimum vitamin E was found in HI-1 (1347-1556). Flavonols was maximum in *H. salicifolia* (350.3 mg), followed by Lahaul form (265 mg), 238.3 mg in HI-1, and minimum in Spiti form (152.7 mg). HI exotic form is rich in fat soluble nutrients.

**СРАВНИТЕЛЬНОЕ ИЗУЧЕНИЕ ДИНАМИКИ
НАКОПЛЕНИЯ БАВ ИНТРОДУЦИРОВАННЫХ
И МЕСТНЫХ ФОРМ ОБЛЕПИХИ
В УСЛОВИЯХ УМЕРЕННО ЗАСУШЛИВЫХ ГИМАЛАЕВ**

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Проведено изучение особенностей накопления биологически активных веществ у ряда подвидов облепихи в различных почвенно-климатических зонах Индии.

THE DETECTION OF WATER-SOLUBLE VITAMINS AND QUANTITATIVE DETERMINATION OF VITAMIN C IN SEA-BUCKTHORN BERRIES

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One of the most common foods enriched by vitamins in Siberia is sea-buckthorn berries containing various vitamins and other biologically active compounds.

The water-soluble vitamins which have antioxidant effect, take part in the oxidative reconstruction reactions of the organism and in the tissue metabolism are the most interesting.

In latest years water fraction from sea-buckthorn berries is often used as vitamin addition to juices, jams and other foodstuffs.

The control of vitamin contents and level of their safety is very important for estimation of their usage not only in drug dosage form but in the structure of phyto-genous products.

In view of the aforesaid, the aim of our research is detection of water-soluble vitamins in sea-buckthorn berries by chemical and physical methods and quantitative determination of the vitamin C (high-performance liquid chromatography) by these two methods.

The subject of the research is working standard samples of water-soluble vitamins (C, B₁, B₂, B₃, B₆, P, Bc) and water fraction of sea-buckthorn berries of the following types "Altaiskaya", "Djemovaya", "Elisaveta".

Preliminary tests of vitamins in the water fraction of sea-buckthorn berries of the following types "Altaiskaya", "Djemovaya", "Elisaveta" with the help of chemical reactions by the pharmacopeia methods have shown the presence of vitamins C, B₃, B₆, P, Bc. The presence of other vitamins was probably impossible to detect by

chemical methods. The presence of these vitamins was proved by absorption spectrums and holding time read by the liquid chromatograph “Milichrom A-02”.

The quantitative determination of the ascorbic acid was made by two methods: by pharmacopeia method of 10th edition (USSA) and with the help of high-performance liquid chromatography. The results obtained by the pharmacopeia method were higher than by high-performance liquid chromatography.

Our studies have shown that while analyzing water-soluble vitamins in sea-buckthorn berries we should use not only chemical but also physicochemical methods to obtain the most reliable results.

Key words: sea-buckthorn berries, water-soluble vitamins, high-performance liquid chromatography, ascorbic acid.

ОПРЕДЕЛЕНИЕ ВОДОРАСТВОРИМЫХ ВИТАМИНОВ И КОЛИЧЕСТВЕННАЯ ОЦЕНКА ВИТАМИНА С В ПЛОДАХ ОБЛЕПИХИ

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Представлены результаты идентификации водорастворимых витаминов в плодах облепихи физическими и химическими методами, а также приведена количественная оценка содержания витамина С в сортах облепихи алтайской селекции. Проведено сравнение результатов оценки содержания водорастворимых витаминов при использовании химических фармакопейных методов и методов жидкостной хроматографии.

THE SYSTEMATIC IDENTIFICATION OF CHEMICAL COMPONENTS OF SEABUCKTHORN JUICE

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The juice of Seabuckthorn (*Hippophae rhamnoids* L.) barriers is very rich in different nutrients. As the form of fruit juice concentrates or ready to drink fruit juices, the beverage from this juice is produced in the large-scale in China as well as in other country. The chemical components of the juice are necessary for the correct production and utilization of the juice. In this work it was experimentally measured the main nutrients including vitamins, flavonoids, carotenoids, organic acids, amino acids and proteins, dietary fibers, lipids and oils, sugars and polysaccharides, mineral elements, and others. In comparison to the other fruit beverages, the main characters of Seabuckthorn Juice are very high concentrations of Vitamins C and E. Also, the high level of bioflavonoids was found, especially the glycosides of quercetin, kaempferol and isorhamnetin.

Key words: Seabuckthorn Juice; Chemical Components; Identification; Vitamins; Flavonoids

СИСТЕМАТИЧЕСКАЯ ИДЕНТИФИКАЦИЯ КОМПОНЕНТОВ БИОХИМИЧЕСКОГО СОСТАВА ОБЛЕПИХОВОГО СОКА

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Проведено всестороннее изучение биохимического состава облепихового сока. Показано более высокое содержание витаминов С и Е, а также флавоноидов в облепиховом соке по сравнению с другими плодовыми соками.

EXPERIMENTAL DETERMINATION OF FREE AND TOTAL AMINO-ACIDS IN SEABUCKTHORN JUICE

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Seabuckthorn (*Hippophae rhamnoids* L.) juice is obtained from its berries, the composition of which is very complicated indeed. In fact this juice is a suspension with different chemical components including free amino acids, peptides and proteins, which may need to

be characterized by different methods. Free amino acids were directly extracted from barriers and analyzed. Peptides and proteins should be hydrolyzed to free the amino acids before analysis. The analyses of the hydrolyzed matrices will give ‘total’ amino acids, which means those amino acids that were part of proteins as well as any free amino acids. So the amounts of amino acids before and after the hydrolysis give the relative quantities of free amino acids and proteins. In the fresh juice 16 kinds of amino acids were detected in the free form, the amount of which was about 36 mg/100g juice. At the same time the amount of amino acids obtained after the hydrolysis was 560 mg/100g juice. It was concluded that the free amino acids were only a small percentage of total amino acids in Seabuckthorn juice.

Key words: Seabuckthorn Juice; Amino-acid; Protein

ЭКСПЕРИМЕНТАЛЬНОЕ ОПРЕДЕЛЕНИЕ СВОБОДНЫХ И ОБЩИХ АМИНОКИСЛОТ В ОБЛЕПИХОВОМ СОКЕ

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Представлены результаты анализа облепихового сока на содержание свободных и общих аминокислот. Выявлено 16 свободных аминокислот в свежем облепиховом соке, что составило лишь 6 процентов от общего количества аминокислот в исследуемом материале.

**PROCESSING / PRODUCTS /
/ INDUSTRY DEVELOPMENT / MARKETING**

**ПЕРЕРАБОТКА / МАРКЕТИНГ /
/ ПРОМЫШЛЕННОСТЬ**

**THE OPTIMIZATION OF PROCESSING TECHNOLOGIES
OF SEA BUCKTHORN NECTAR TO INCREASE
THE SHELF LIFE OF THE PRODUCT**

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Sea buckthorn fruits very unique among the world's natural products. They contain natural antioxidants, amino acids, vitamins as well as 150-200 various physiologically active compounds. They are also unique with the content of four omega-fatty acids (ω -3, ω -6, ω -7, ω -9).

Sea buckthorn fruits are suitable for production of different products. Widely known are such products as juice, syrups, various purees, jams, jellies, sauces, alcoholic and non –alcoholic drinks. According to the scientists verity sea buckthorn fruits possess high antioxidant activity that can slow down the cause of many diseases and after effects.

Although sea buckthorns are considered to be unconventional culture in Latvia they have become popular during the last two decades. The industrial processing of sea buckthorn fruits started to develop during the last two years. The main products are fresh sea buckthorn nectar and frozen sea buckthorn juice. Small enterprise “Satori Alfa” has elaborated the new original technology for fresh sea buckthorn nectar production and this product has been introduced in the supermarket system of Latvia. This technology allows to reach full removal of seeds and to turn the fruit peel in the nectar. One of the problems for consumers is still the short self life of this product.

In the investigation of sea buckthorn nectar the attention was turned on the possibility to increase the product stability – to decrease the auto-oxidation and to eliminate the contamination with bacteria and fungi, thus increasing the product shelf life.

The research was carried out at the Experimental Fruit and Berry Processing Centre, Latvia State Institute of Fruit-Growing and at the Institute of Microbiology and Biotechnology, Latvia University during 2008. The object of the research was fresh sea buckthorn nectar produced by “Satori Alfa” Ltd. In order to increase the product’s shelf-life addition of N₂ to the nectar during the bottling and pasteurization at the temperatures 65 °C and 80 °C was tested. The samples were stored at the refrigerator (+4±1°C). The total duration of the experiment was 30 days. Biochemical analyses: vitamins (B group, C and E), content of total phenol compounds and amino acids were made after 10 and 30 days of storage.

Amount of mesophilic aerobic and facultative anaerobic microorganisms (MAFA) and CFU of yeasts and moulds in one gram of the sample were tested in order to determine the period of validity during the storage.

The data were statistically analyzed by using SPSS for Windows and MS Excel.

Key words: sea buckthorn, processing, nectar, self-life

ОПТИМИЗАЦИЯ ТЕХНОЛОГИЙ ПЕРЕРАБОТКИ НЕКТАРА ОБЛЕПИХИ ДЛЯ УВЕЛИЧЕНИЯ СРОКА ХРАНЕНИЯ ПРОДУКТА

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При исследовании нектара облепихи уделялось большое внимание возможности увеличения стабильности продукта посредством снижения окислительных процессов и устранение заражения бактериями и грибами. Изучено добавление N₂ в нектар при розливе и пастеризации при температуре 65 и 80 °С. Представлены результаты оценки количества аэробных и анаэробных микроорганизмов, дрожжей и плесневых грибов в процессе хранения.

DEVELOPMENTS IN SBT PROCESSING A MUST FOR INTERNATIONAL TRADE AND CON- SUMERS SAFETY

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Seabuckthorn is widely used in industries. Technologies for processing differ sometimes dramatically. In result of different processing techniques quality of produced raw, semi- and final products have a wide range of properties. On the other hand Seabuckthorn

became an important good in international trade and great amounts are sold world-wide. It is an important task for the next years to find international acceptable standards for quality parameter and properties to expand international trade and to bring up better consumers safety.

Quality and properties of Seabuckthorn are influenced by the most important factors:

- Fruit properties
- Harvesting technology and conditions
- After harvest handling / storage
- Technology of processing
- Conservation of raw and semi-products
- Technology and design of final products

Whereas first topic is strongly depending on species and local factors (climate) the following can be influenced by the processors. It has been shown that especially the influence of enzymes on raw materials (pectin degradation) and of micro-organisms (degradation, spoilage) have great influence on all following processes. The properties of raw products (acidity, content on enzymes and vitamins, physic-chemical properties) influence the possible applications, the stability of the final products and last but not least the acceptance to consumers. Especially the need of high quality and safe products make it difficult to producer not to look on raw material. So high levels of requirements are the result.

Simple pressing technology of Seabuckthorn today does not lead to acceptable product quality. The presence of pectins and their influence on appearance and taste is very important. Enzymatic treatment of Seabuckthorn-raw-juice make it possible to control this important property. Losses on vitamins and formation of unacceptable by products (off flavours, tails, PAH's and other) are not acceptable to further processing. Only sophisticated processing technology give the necessary safety to prevent these by-products.

One of the main quality parameters are taste and smell. Consumers expectance Seabuckthorn products differ widely regionally. Southern regions expect more sweet products, northern regions more sour. But not only sweetness influence consumers acceptance. Also

absence of the typical buck-smell and presence of a fruity component are important. For product development and resulting technology knowledge of these parameters and consideration during product development are important. Thus there is no general exact description how a product should taste and smell and producers should take into account that one product line can differ from region to region.

Key-words: Seabuckthorn, technology, product quality, taste, smell

**СОВЕРШЕНСТВОВАНИЕ ПЕРЕРАБОТКИ ОБЛЕПИХИ
В НАПРАВЛЕНИИ РАЗВИТИЯ
МЕЖДУНАРОДНОЙ ТОРГОВЛИ И БЕЗОПАСНОСТИ
ДЛЯ ПОТРЕБИТЕЛЕЙ**

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Описаны основные факторы, влияющие на качество и свойства продуктов из облепихи. Показано негативное влияние энзимов и микроорганизмов в сырье на дальнейшие этапы переработки. Предъявлены жесткие требования к качеству сырья и конечным продуктам.

Рассмотрены недостатки существующих технологий переработки и предложены варианты их совершенствования.

Анализируются органолептические приоритеты потребителей в различных регионах страны.

STUDY ON SEPARATION PROCESS AND NUTRIENT VALUE ANALYSIS OF SEABUCKTHORN

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The process of pure peel separation from fruit residues after the juice was squeezed from sea buckthorn was studied, the nutrients in the peel were analysed. The microbes and heavy metals were subsequently measured. The results showed that seabuckthorn peel has abundant nutrients, which could be excellent under scientific and reasonable processing excipient to food.

Key words: seabuckthorn peel; antioxidation; function food

ИЗУЧЕНИЕ ПРОЦЕССА СЕПАРАЦИИ СОКА И АНАЛИЗ ПИТАТЕЛЬНЫХ ВЕЩЕСТВ В ОБЛЕПИХЕ

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Изучен процесс отделения кожицы плода облепихи от мезги после отжатия сока. Представлены результаты анализа кожуры на содержание тяжелых металлов, питательных веществ, а также микробиологический анализ. Результаты показали, что в кожице содержится большое количество биологически активных веществ, что позволяет рассматривать эту субстанцию как ценную добавку к пище.

SUPERCritical CO₂ EXTRACTION OF SEABUCKTHORN FRUIT OIL

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Depending on origin and variety, Seabuckthorn (*Hippophae rhamnoides* L., Elaeagnaceae) fruit (puree) oil can contain 10-20% oil. Pulp oil is rich in palmitoleic acid (omega-7), palmitic acid, linoleic acid (omega-6), carotene compounds, and beta-sitosterol. Supercritical carbon dioxide extraction (SFE-CO₂) was used to extract oil from the seabuckthorn fruit (cv. Indian Summer). SFE-CO₂ extraction offers a low temperature, environmentally-friendly, and high yielding process versus conventional solvent and cold press extraction methods. Seabuckthorn fruit puree was prepared by mechanically removing the seeds and skins. The resulting puree was freeze-dried to produce the dry matter which was used for oil extraction. Extractions were carried out for three hours at four different pressure levels: 200, 250, 300 and 350 bar with constant temperature and flow rate of CO₂ at 40°C and 100g/min, respectively. Oils obtained at different pressures were analyzed for fatty acid profile and other significant components such as sterols and tocopherols, as well as carotenoids. Defatted cakes obtained at each pressure were analyzed for moisture content, carbohydrate, protein and residual oil. Based on maximum oil yield and quality and minimum residual oil in defatted cakes, optimum process conditions will be identified for SFE-CO₂ extraction of seabuckthorn fruit oil.

Keywords: Seabuckthorn, Puree, Freeze drying, Supercritical fluid extraction, Oil

УГЛЕКИСЛОТНАЯ ЭКСТРАКЦИЯ ОБЛЕПИХОВОГО МАСЛА

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Представлены результаты исследования различных режимов экстракции облепихового масла двуокисью углерода. Предложены оптимальные параметры технологического процесса, исходя из количества и качества полученного продукта, а также потерь масла в процессе экстракции.

UTILIZATION OF CENTRIFUGAL FORCES FOR PROCESSING SEA-BUCKTHORN ON A QUALITY TOP LEVEL

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The juice and the oil from the sea-buckthorn fruit are considered as very valuable products for the nutrition of human beings. To transfer the high content of beneficial ingredients into the oil and juice, a gentle and efficient process is required.

Over the last years the decanter technology has gathered a reputation as a device to achieve top quality products from various fruits. Main topics for the decanter are:

- Gentle separation of juice from the pomace by centrifugal forces
- De juicing by centrifugal forces ensures a rapid process without stress

- A maximal carryover of valuable compounds
- A closed system for a hygienic and oxygen free process
- Continuous process

Using the decanter to gain the juice from the sea buckthorn fruit is the first step in a quality process chain. Further on the juice has to be separated from the oil. The oil is a bio active compound and as this it is important that newest separator technology is applied. This means a gentle treatment of the product inside the machine to avoid the generation of stable emulsions, which are nearly not possible to be processed. Further on a discharge of the different phases under pressure in a closed system avoids an additional oxidization.

The knowhow about the characteristics of the sea buckthorn combined with new technology equipment ensures a top class end product according to the state of the art.

Westfalia Separator as the world wide biggest manufacturer of decanter and separators for the food industry provides not only the single components even complete processing lines.

ИСПОЛЬЗОВАНИЕ ЦЕНТРОБЕЖНЫХ СИЛ ДЛЯ ВЫСОКОКАЧЕСТВЕННОЙ ПЕРЕРАБОТКИ ОБЛЕПИХИ

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В работе показана исключительная важность производства продуктов переработки облепихи с сохранением всего комплекса биологически активных соединений. С этой целью предложена передовая технология декантирования, сочетающая новые технологические подходы с применением более современного оборудования.

THE INNOVATIVE TECHNOLOGIES OF COMPREHENSIVE PROCESSING OF SEA-BUCKTHORN

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In considering the functions of the innovation management the technology is a set of techniques and methods of handling and processing of various media. The combination of technological operations of the manufacturing process as a result, which occurs a qualitative change in processing environments, their shape, structure, material, technical and consumer properties. The potential benefits of foods produced with the help of innovative technologies provide an improved process for production and packaging, superior taste and nutritional properties of the new content at the expense of medical nutrition.

The optimal time of collection of fruits - one of the conditions to ensure high quality products. To establish criteria for the maturity selected the most important for freezing, cold storage and processing on the properties of sea-buckthorn oil: consistency, modulus of elasticity of fruit content of soluble dry matter, sugar content, lipid content, nitrate content, total acidity. The method of scoring organoleptic evaluation of fresh and frozen sea-buckthorn is equipped with a specially created metric scale and the weight coefficients of individual organoleptic indicators.

We have proposed a new technology for complex processing of sea-buckthorn. Technological conditions and modes of processing buckthorn allow to preserve biologically active substances.

The collection of commercial batches of varietal buckthorn and experimental samples of promising hybrids was carried out at five dates during the period of gestation the mass harvesting of fruit

In technologically fresh fruit destined for processing at sea-buckthorn oil, have difficulty with the value of juice and pulp from the seeds of separation in the disintegrator, a part of the pulp remains on the seeds. When processing the frozen fruit pulp ensured complete separation of seed.

Freezing was carried out in rapid freezing Machinery continuous ectoplasmatic type (Z 413) with the bulk air temperature minus 30 ° C until the temperature in the center of the fruits of minus 18 ° C. The raw materials entering into the tunnel was at its entrance through the installation of vibration, which is evenly distributed on the raw transport belt tunnel. Transporter carries fruit ectoplasmatic flow through an ice layer of air. Blow air through the wire belts in the tunnel system provides fans and channels freezers, which makes it impossible to grip buckthorn fruit in clusters.

Resulting in new technology sea-buckthorn oil content of carotenoids and other parameters is fully consistent with the requirements of the Pharmacopoeia oil, and can be used not only as a medical product, but also as a valuable raw material for the production of a number of food.

A comprehensive assessment of the quality of fresh and frozen sea-buckthorn helped establish the suitability of different varieties for processing into sea-buckthorn oil, juice and other areas of processing.

ИННОВАЦИОННЫЕ ТЕХНОЛОГИИ БЕЗОТХОДНОЙ ПЕРЕРАБОТКИ ОБЛЕПИХИ

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Описаны инновационные подходы к переработке плодов облепихи, позволяющие на разных этапах технологического процесса добиваться оптимальных результатов. Большое внимание уделено срокам уборки урожая, а также методам заморозки сырья, как наиболее важным элементам технологической цепочки.

SEA BUCKTHORN JUICE CLARIFICATION

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Clarified sea buckthorn juice is of interest as prepared food in fabrication of blended fruit-vegetable juice, vine materials and number of other foodstuffs.

The production of clarified sea buckthorn is difficult technical problem to be solved by means of its treatment with natural mineral sorbents. It was determined that the required amount of sorbent made 4-8 % if juice mass resulting effective clarification. But it also will waste in the same juice loss amount if sorbent humidity is taken equal to 50 % after use.

The purpose of our work was study of feasibility of seabuckthorn juice clarification by means of bentonite. Raw juice was treated with 1-7 gm/l of 5% water suspension calculated as dried bentonite.

As a criterion of clarification completeness, the juice turbidity was chosen and turbidimetric method of estimation was used.

It is possible to classify sea buckthorn turbidity depending on the amount of bentonite used into two stages. Aggregation of solid phase and juice oil with bentonite and their precipitation appear to have taken place at the first stage (0-3 gm/L) and clarification of colloidal solution the second stage (3-7 gm/L).

Thus, the use of bentonite under seabuckthorn juice treatment enable production of clarified juice with good tasting indices that does not separated into layers form oily phase if being kept.

Keywords: sea buckthorn juice, bentonite, turbidity.

ОСВЕТЛЕНИЕ ОБЛЕПИХОВОГО СОКА

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Представлены результаты исследований процесса осветления облепихового сока с использованием бентонита. Установлена его высокая сорбирующая эффективность, сочетающаяся с сохранением специфического комплекса органолептических характеристик.

THE METHODS OF SEA-BUCKTHORN JUICE PRESERVATION

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The review of literature origin shows that the sea-buckthorn is raw-material of high food value with prophylaxes and treatment meaning. It contains remarkable quantity of substances that have tin- and phitonicid properties: organic acids, polyphenols (catechins, leikoantocians, antocians), amino-acids. The wider use of this culture will be of great importance for the providing of people with valuable food products.

The purpose of our research is right complexes use of sea-buckthorn fruits, extension of natural products with high biological value and diet direction.

The use of free picked up juice, which was made of sea-buckthorn concentrate, is a problem for pharmaceuticals production and remaking sphere.

Acidity, maintenance of dry substances is chemical factors with the influence on quality of such juice. The directions for firming of acidity, preservation of negative substances in juice are the purpose of our research. Well-timed juice, additional use of technological operations, such as pressing, aseptic tinning and tinning of warm sterilization and UV-radiation will give an opportunity to preserve own properties of fruits in our juice and to use it in natural condition or as a half-finished product for getting of fruit-berry sweet.

We examined the influence of tin-elements and of temperature treatment on quality of juice and on its preservation. The juice quality in the process of storage was estimated according to the maintenance of its dry substances and acidity, as soon as to its organoleptic properties: color, taste, smell.

It was tasted in the organization "Sibirskoye", which had its own raw material sources. The juice was gathered in the period of technical maturity of sea-buckthorn. The juice was selected on the second day, to this moment slow fermentation has already begun. Then the maintenance of its dry substances was 10,4%, and acidity-18,9 g/l (with the apple acid).

For the averting of its next fermentation, sodium benzoate and Ka sorbat were carried in the juice, temperature of 90% during 5, 10, 15 and 20 minutes. Ka and Na did not stop the process of fermentation, and ferment activity was observed.

The maintenance of organic acids in the process of storage increased, in common, on 14%) in comparison with the last one. This increase, we think, is the result of phenolcarbonum- and oxycoricum acids, as soon as first acidity of monosugars.

Dry substances decreased (10,4%-8,39%). It was the result of acid hydrolyze, which took place during the warming. We analyzed all the results and noted that warm treatment influences the juice preservation well during 3 months, in spite of insignificant change of physics-chemical figures.

МЕТОДЫ ХРАНЕНИЯ ОБЛЕПИХОВОГО СОКА

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Проведено изучение технологических аспектов производства облепихового сока с целью увеличения сроков хранения и улучшения качества продукта.

THE DEVELOPMENT OF SEABUCKTHORN INDUSTRIALIZATION IN CHINA

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The paper introduced the distribution and characters of seabuckthorn resources in China. Seabuckthorn have been accepted by more and more people due to its high social , ecological and nutritional values in China today. The rich resources make the industrial production be realized. The new picking method and advanced cold pressing and fresh fruits fast separating technology are applied to improve greatly not only the production efficiency but also the juice quality. Multiple seabuckthorn products and extracts have been developed widely used on the fields of foodstuff, healthcare products, medicines, cosmetics as well as fodder. The extends of seabuckthorn industrial chain make the complete utilization on seabuckthorn without any waste. We can see that seabuckthorn industrialization have been developed well in China.

Key words: Seabuckthorn; Industrialization; Utilization without waste

РАЗВИТИЕ ОБЛЕПИХОВОЙ ОТРАСЛИ В КИТАЕ

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Рассмотрены географическое распространение и особенности облепиховых ресурсов в Китае. Описан новый метод сбора плодов, метод холодного прессования, технология быстрого отделения плодов и др. Показано, что расширение направлений использования позволяет добиться безотходной технологии переработки облепихи.

CHINESE SEABUCKTHORN INDUSTRIAL DEVELOPMENT EXISTENCE PROBLEMS AND PROSPECTS

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In view of the Chinese sea buckthorn development present situation, pointed out the Chinese sea-buckthorn industrial development existence the question. Proposed that under the policy support, completes the sea-buckthorn resources the construction, take high technology as support, take depth and comprehensive industrialization as development model impetus seabuckthorn industrial development.

Key words: Seabuckthorn; development; problem

ПРОБЛЕМЫ И ПЕРСПЕКТИВЫ РАЗВИТИЯ ОБЛЕПИХОВОЙ ОТРАСЛИ В КИТАЕ

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В статье рассматриваются вопросы развития облепиховой промышленности в Китае. Показана необходимость государственной поддержки, а также применения современных технологий в отрасли.

SEABUCKTHORN INDUSTRIALIZATION IN BOLIVIA

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The present project, has the objective to demonstrate the feasibility of create an enterprise to produce Natural Juice and Green Tea to industrial scale through the Seabuckthorn in the Municipality of Santiago de Callapa in the middle term.

The first part of the Project, have done an investigation of the nutritional qualities and medicinal proprieties of the fruit and leaf obtained in the Municipality of Santiago de Callapa.

Considering the versatility of the Seabuckthorn, the technology that requires for transforming to an industrial product, the investment capacity and the own conditions of the municipality, allow to produce Natural Juice and Green Tea of Seabuckthorn.

The second part have done the study of the Research Market, doing different tests (differentiation test, importance test, perform-

ance test and buy intention test) with sampling of the products that allowed measure the perception, acceptance and purpose of purchase the products.

The third part has two ways: the first show the technological study to produce natural juice and green tea, and the second shows the economic evaluation and the benefits for the municipality of Santiago de Callapa.

The results are:

- By means of study of the SELADIS laboratory, it verifies that the fruit and leaf of the Seabuckthorn have different benefits nutrients to the human body, even compared with another plants of the Bolivian ecosystem.

- The research market has shown that the 91.7% of the people could difference the juice of the seabuckthorn like the one in the Bolivian market. With the results of the importance and performance test, it could make the perception map for the juice and the green tea, verifying that the attributes that they have are very acceptable for the consumers. Besides it registered that the secured purchase percentage in both products are more than 40%, which secure the successful of the enterprise to establish.

- The potential demand of the juice and the tea are bigger than the supply.

- The evaluated Project to the 16% and 20% rate for the industrial plants of juice and green tea, shows an VNA of \$US 9.877 and 6.157 respectively, and 21% and 23% of return on equity respectively.

- The Project will generate a social economic benefit that represents 66 new jobs that will benefit to the most of the people of Santiago de Callapa.

With this results it recommends to execute the project in the short time and increase the cultivate areas in the municipality and other adjuncts places. Besides to give social and economic benefit, the seabuckthorn cultivation give us ecological benefits, because the place that before were unproductive and eroded now are productive and a source of incoming benefits through the sells of the fruit and leaf of the Seabuckthorn.

Key words: Seabuckthorn, feasibility, economic evaluation, consumers, potential demand, social economic benefit.

РАЗВИТИЕ ОБЛЕПИХОВОДСТВА В БОЛИВИИ

Антониа А. Маркез, Цезар Д. Портилльо Арано

Боливия

Представлен поэтапный проект производства в промышленных масштабах натуральных соков и зеленых чаев на основе облепихи в районе Сантьяго Де Каллапа (Боливия). Показан экономический и социальный эффект от осуществления проекта.

HIPPORHAE AS A "BUSINESS CARD" OF ALTAYVITAMINY PHARMACEUTICAL COMPANY

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Hippophae has been being used a "business card" of Biysk Vitamin Plant (now recognized as Altayvitaminy) for a half a century. The 55 years history of our enterprise is inseparably associated with Sea buckthorn. This plant plays an important role for the enterprise development. Our enterprise was the first to have started the manufacture of Sea buckthorn oil under support of the Moscow Vitamin Institute's scientists in the USSR. The Biysk plant has been the only one and the biggest Sea buckthorn oil supplier to Russian pharmacy net, to former Soviet Union countries and other countries for a long time. The Biysk plant is still at the same position.

The active investigations on Sea buckthorn chemistry, technology, pharmacology, and its processing products in cooperation with scientific institutes contributed to elaboration and introduction of

advanced technologies and new preparations. The Pharmaceutical Company “Altayvitaminy” is the Biysk Vitamin Plant’s successor. The Biysk Vitamin Plant was established on the basis of the shops of a town foodstuffs enterprise to manufacture vitamin products from local raw materials in January 1949. The most important event in Plant activities in 1954 was the first pilot batch of Sea buckthorn oil. It was Sea buckthorn that mainly predetermined further destiny of the enterprise. The elaboration of more progressive dosage forms began simultaneously with investigations and development of Sea buckthorn technology. The aerosol medicinal preparations with Sea buckthorn oil “Olasolum”, “Hiposolum”, “Statisol”, collagen film “Oblecol” were manufactured in cooperation with various scientific research institutes.

Last year, the productions of more than 30 kinds of original Sea buckthorn products were developed: medicinal aerosols and cosmetics (Protective Hand Cream with Sea buckthorn), soft capsules (“Altai” with Sea buckthorn oil (Biologically Active Supplements, BAS) and “Sea buckthorn Oil”) and suppositories (“Olestezin”), extracts and syrups, dried beverages (VitaLife™ “Sea buckthorn” with micronutrients) and dragees (VitaLife™ “Oblepishka”), solvent cakes and foodstruffs (Dried fruit jelly VitaLife™ “Sea buckthorn”). In 2007 our Company has got the International Certificates ISO 9001:2000 and HACCP.

Up to now, Sea buckthorn and products of its processing are a principle development direction of our enterprise. A new 100 ha garden was installed in 2007-2008. “Altayvitaminy” has got a machine for liquid filling soft gelatinous capsules. For example, BAS “Altai” with Cedar nut oil and Sea buckthorn oil (0,5 gramm)

Now we are involved in development of complex processing of Sea buckthorn to obtain juice and oil from its pulp and seeds for food and cosmetic industries. A vinegar production process has been worked out by our engineers from Sea buckthorn juice. A pro-biotic fodder additive obtained from Sea buckthorn solvent cakes for farm animals has been registered now. An ointment based on Sea buckthorn oil is being elaborated by our pharmacutists.

Key words: Altayvitaminy, Pharmaceutical preparations, Sea buckthorn oil, medicinal aerosols, Biologically Active Supplements, syrups, capsules, cosmetics.

**ОБЛЕПИХА – ВИЗИТНАЯ КАРТОЧКА
ФАРМАЦЕВТИЧЕСКОЙ КОМПАНИИ
ЗАО «АЛТАЙВИТАМИНЫ»**

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Описаны этапы становления, развития и современное состояние компании ЗАО «Алтайвитамины», являющейся основным переработчиком облепихового сырья в России. Представлены наиболее заметные разработки в области фармакологических препаратов, содержащих облепиховую основу.

THE PRACTICAL USE OF THE SEA-BUCKTHORN JUICE

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The sea-buckthorn, in comparison with other fruit-berry plants, there are almost all main water- and grease instant vitamins and provitamins. The sea-buckthorn is not the same as the other, according to the maintenance of tocopherol (vitamin E), Beta-carotene (provitamin A), phillohinol (vitamin K1). Because of high maintenance of well-known and very useful vitamin C, the sea-buckthorn is not comparative with the black currant, and some its forms are almost the same as the champion-wild hedge rose. The fruits of Altai sea-buckthorn contain sticky pectin substances, their quantity – 0,6-1,2%. Also the sea-buckthorn fruits contain other sticky substances and p-active combinations.

That is why the creation of new sea-buckthorn products attracts great attention.

There is normative-technical documentation to the theme of fruit-berry sweets: the apple-black rowan-berry "Contata", the apple-cherry "Slavyanka".

The well-known fruit-berry sweet is made of apple puree with dark fruits and berries, which are boiled in the sugar mixture.

According to this instruction only fresh cherry, black rowan-berry and apples are useful there are valid norms about fresh raw material; fast frozen cherry, black rowan-berry, black currant, sterilized apple puree and apple puree, which is tinned with the sorbin acid, sugar and drink water.

As the basis for this fruit-berry sweet "Sea-buckthorn" sea-buckthorn is useful (also Na alginate, sweetener, with or without tin substances). Na alginate, which is useful for the creation of this sweet, in the result of exchange reactions with calcium alginate, that has powerful sorbent ability according to the toxic salts of heavy metals (lead, cadmium, mercury), radionuclide's (radioactive isotopes of strontium, cesium, rubidium). Owing to use of sweetener instead of sugar this sweet concerns to the diet tinned products for people with limited use of sugar.

The production of tinned goods with sea-buckthorn, first of all, has the meaning, when all the vitamins are maximum preserved. The research in this sphere plays an important part, because the production of tinned goods with guaranteed contents of vitamins is one of actual problems of modern tinned production. Selection of sparing regimes for warm treatment of juice, exception of temperature treatment in the phase of sweet come out, gives an opportunity to get the product with optimal contents of vitamins.

ПРАКТИЧЕСКОЕ ИСПОЛЬЗОВАНИЕ ОБЛЕПИХОВОГО СОКА

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Представлены направления использования облепихового сока при производстве плодово-ягодных десертов.

COMMERCIAL APPLICATION OF SCIENTIFIC INVESTIGATIONS ON SEABUCKTHORN

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In the middle of the last century investigations on sea-buckthorn were carried out in Altai, the first varieties Novost Altaya, Dar Katuni, Zolotoy Pochatok have been developed and the work in working out of cultivation and propagation technologies began. At the same time commercial plantations of this crop were established in different enterprises at Altai.

Scientists and production workers were interested in this crop not only in Altai, but beyond its borders as well as abroad.

Working on the development of sea-buckthorn varieties and technologies, scientists pay a great attention and take part in establishment of new gardens and nurseries. With their help commercial plantations and nurseries are developed in Novosibirskiy, Omskiy, Tomskiy, Irkutskiy, Permskiy, Chelyabinskiy and other regions and districts of Russia, as well as in Kazakhstan, Ukraine, Moldavia, Caucasus and other regions. For realization of the program nurseries of LRI of horticulture for Siberia grew more than 700 thousands seedlings annually. At the period of economic recession the work stopped. But lately applications for research-consultative and practical help in establishment and reconstruction of sea-buckthorn plantations, replacing old varieties with new ones, more productive, with high flavouring and technological properties are made to the institute.

Seedlings growing technology from soft-wood cuttings played an important role in increasing the quantity and reducing the cost price of seedlings. In this case, film green-houses and automatic mist-forming sets were used, worked out by scientists of M.A. Lisavenko RI of horticulture fro Siberia jointly with engineers of the Siberian physical-technical institute of agrarian problems. Such technology is practically used in all fruit-nursery economies of Siberia.

For the last years an intensive technology of seedlings growing with the closed root system and application of green- houses twice a season was worked out and begun to use by scientists of the Lisavenko institute of horticulture. The technology allows to improve the quality of seedlings, increase the products output from the unit of the closed ground in 1.8-2.0 times and shorten the terms of planting material growing a year.

Key words: investigations, sea-buckthorn, cultivation, seedling, growing, green-house, technology, crop.

ВНЕДРЕНИЕ НАУЧНЫХ РАЗРАБОТОК ПО ОБЛЕПИХЕ В ПРОИЗВОДСТВЕ

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НИИСС имени М.А. Лисавенко, Россия

Представлены наиболее заметные научные разработки по облепихе ученых НИИСС имени М.А. Лисавенко, показаны результаты их применения на практике.

NUTRITIONAL QUALITY AND VALUE ADDITION OF SEABUCKTHORN BERRIES OF LAHAUL AND SPITI REGIONS OF HIMACHAL PRADESH

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The present study was carried out on three Seabuckthorn fruit samples procured from Lahaul (V₁- *Salicifolia* sp, V₂- *Rhamnoides* sp) and Spiti (V₃- *Rhamnoides* sp) regions of Himachal Pradesh. The

Seabuckthorn pulp was extracted as per the standardized extraction techniques. The extracted pulp was strained, bottled and processed at $80 \pm 5^{\circ}\text{C}$ for 30 minutes. The physical evaluation of Seabuckthorn berries with respect to length, width and weight reveals that berries of *Salicifolia* sp from Lahaul area were longer (0.87cm), wider (0.73cm) and heavier (0.21g) as compared to *Rhamnoides* sp from Lahaul and Spiti regions. The total soluble solids (TSS) of V_2 was higher (12°B) as compared to V_1 (9°B) and V_3 (10°B). The mean value of Ascorbic acid content was present in the range of 543 -549 mg/100g with higher value in V_1 . A slightly higher value of acidity was observed in V_1 (2.73 % as citric acid). The recipes were formulated/ standardized for preparation of value added products viz RTS, squash, syrup, jam, jelly and marmalade. The value added products were prepared from in combination with juice/ pulp of apple, kiwi, guava and rhododendron. The developed/ standardized products were evaluated for nutritional relevance and consumer's acceptability on the basis of colour, flavour, mouth feel and taste characteristics of the products.

ПИЩЕВАЯ И БИОХИМИЧЕСКАЯ ЦЕННОСТЬ ПЛОДОВ ОБЛЕПИХИ РЕГИОНОВ ЛАХАУЛ И СПИТИ ШТАТА ХИМАКАЛ ПРАДЕШ

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Дана оценка питательной ценности облепихи, а также возможность использования ее в качестве ценного ингредиента при производстве купажированных пищевых продуктов.

PREPARATION AND ACCEPTABILITY OF DEHYDRATED SEABUCKTHORN POWDER

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The different drying methods were tested for the preparation of Seabuckthorn powder. The main objective of drying/ dehydration of Seabuckthorn pulp was to get a good quality powder both nutritionally as well as organoleptically. The trail of drying in hot air oven in which the Seabuckthorn pulp was spread over tray and dried at $55\pm 5^{\circ}\text{C}$ and after 5-6 hours of drying turned brown and was sticky to handle. The thin film freeze drying method tested for preparation of Seabuckthorn powder produced good quality powder in respect of colour and texture but as soon as brought to normal or room temperature it lost its consistency and thus was not stable. The reasons for not obtaining the suitable quality powder from Seabuckthorn were presence of oil and sugar contents of the fruit and these constituents were responsible for changes in colour and sticky texture of the dried pulp. The further trail conducted on the separation of the different layers, centrifugation produced better results and oil and water layers were separated out by siphoning. The technique was followed by drying with tray drier. The powder of Seabuckthorn obtained with this technique was of very fine quality and maintained original colour and can be used as base for preparation of various value added products. The technology developed/ standardized can be helpful in establishing entrepreneurs for processing of Seabuckthorn on scientific lines and further helpful in the empowerment of the tribal persons as well as food and nutrition security in the tribal areas.

ПРОИЗВОДСТВО И ИСПОЛЬЗОВАНИЕ ОБЛЕПИХОВОГО ОБЛЕПИХОВОГО ПОРОШКА

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Рассмотрены различные методы сушки облепихового сырья с целью получения продукта, отличающегося повышенной питательной ценностью и высокими органолептическими характеристиками. Показана целесообразность выделения из плодовой массы масляной и водной фракций, с последующей тепловой сушкой.

FUNCTIONAL FOODS FROM SEABUCKTHORN

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Seabuckthorn is an important polyvitaminous antioxidant fruit crop, its fruits are a valuable raw material for obtaining of functional and dietary foods.

On the base of Michurinsk Experimental Centre “M-kons-1” investigations, the design philosophy and production practice were developed. All these refer to natural functional and dietary foods from Seabuckthorn and their enrichment with natural physiologically ac-

tive ingredients taking into account the variety qualities, vitamin content, the number of biologically active substances and other useful components.

“Dietary Stewed fruit of low caloric value from Seabuckthorn” (Specifications 9163-001-14310543-06) is produced from fresh Seabuckthorn varieties “Gordost CGL”, “Krasnoplodnaya”, “350 let Michurinsku”, “Fantastika”, “Scherbinka”, “Yantarnaya”. The fraction of total mass of raw material is about 70%. For enrichment of antioxidant activity in finished product dihydroquercetin is added to the number of 0.067 kg/100 l of syrup and “Swyta” Sweetener – 0.435 kg. When the Seabuckthorn varieties with vitamin C content (more than 100 mg/100g) are used, - ascorbic acid is not added. The production practice includes the preparation of raw material, the preparation of syrup, prepacking, syruring, closure and sterilization. The product contains 41 mg/100g of vitamin C, 30 mg/100g of P-active catechines, 1.2 of pectin substances and 1.3% carbohydrates, 56% of them are considered to be fructose and 44–glucose. Antioxidant activity of product depending on variety is about 630 mkg/ml and energy value – 5.4 kcl/100g. The product is recommended for dietary alimentation, the persons suffering from overweight, cardio diseases and metabolic disturbances may use it.

“Sause vitaminous from Seabuckthorn” (Specifications 9163-004-97000490-07) is produced from the fresh Seabuckthorn fruit with addition of natural spices (cassia bark, clove). Production practice of sauces includes the preparation of raw materials, crush, homogenization, precook, apportioning, pasterization. The product contains 65 mg/100g of vitamin C, 2 mg/100g β -carotene, 4.3% dietary fiber, 0.3 mg% of vitamin B₁, 2.5 mg% - B₂, 0.25 mg% PP, energy value – 80 kcal/100g of product. Sauce is considered to be dietary food and a source of vitamins, carotenes and other components.

Key words: Seabuckthorn, processing formulas, production practice, energy value.

ФУНКЦИОНАЛЬНЫЕ ПРОДУКТЫ НА ОСНОВЕ ОБЛЕПИХИ

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Представлены новые продукты диетического и функционального питания на основе облепихового сырья. Дана их биохимическая оценка, а также изложены технологии производства.

THE PRESENT SITUATION AND PROSPECT OF THE RESEARCH ON THE DEVELOPMENT OF CHINESE SEABUCKTHORN

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Sea buckthorn, being as the most promising nutrition and medicinal plants of the 21st century, is known as "the third generation of human fruit". Sea buckthorn has not only ecological benefits, but also economic and social benefits. It has the largest distribution in China. In this paper, the comprehensive development of Chinese Sea buckthorn resources is showed. The present situation and existing problems of sea buckthorn product have been analyzed. As to these problems, both the measures for improvement and the prospect of the Sea buckthorn industry have put forward.

Key words: Sea buckthorn; development; products; market prospect; envisaged research and development

СОСТОЯНИЕ И ПЕРСПЕКТИВЫ НАУЧНЫХ ИССЛЕДОВАНИЙ ПО ОБЛЕПИХЕ В КИТАЕ

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Описаны различные направления использования облепиховых ресурсов Китая. Проанализировано текущее состояние и проблемы производства продуктов из облепихи. Предложены перспективные пути развития облепиховой отрасли.

PHARMACOLOGY

ФАРМАКОЛОГИЯ

APPLICATION OF SEABUCKTHORN IN TRADITIONAL MEDICINE SYSTEM OF NEPAL HIMALAYAS

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Seabuckthorn is an important native plant species of dry temperate areas of Nepal Himalayas. In Nepal it grows wildly and cultivation is still not in practice. Two species of Seabuckthorn () are found abundantly in northern part of Nepal.

Present paper deals with the history of uses of Seabuckthorn in traditional medicine system. Basically boiled raw juice of the berries of both species is being used by traditional doctors (Amchis) for curing various health problems for human beings and the domestic animals as well.

Key words: Seabuckhorn, Himalayas and traditional medicine

ИСПОЛЬЗОВАНИЕ ОБЛЕПИХИ В ТРАДИЦИОННОЙ МЕДИЦИНЕ НЕПАЛЬСКИХ ГИМАЛАЕВ

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Изложена история применения облепихи подвидов *Hippophae salicifolia* and *Hippophae tibetana* в традиционной медицине Непала.

THE EFFECT OF SEABUCKTHORN EXTRACT IN THE TREATMENT AND PREVENTION OF GASTRIC ULCERS IN HORSES

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Non-glandular (NG) gastric ulcers are common in horses. Current pharmaceutical treatments are expensive and alter the acidic environment of the stomach. Seabuckthorn (*Hippophae rhamnoides*) has been shown to be useful for the treatment of gastric ulcers in humans. The purpose of this study was to evaluate the efficacy of a commercially sold extract of seabuckthorn berry (SBC: SeaBuck™ Complete Liquid) in the treatment and prevention of gastric ulcers in horses.

This study was a blinded 2-period cross-over design using 8 adult female horses. Each treatment period consisted of a control group, that received feed only, and a treated group that received SBC (3oz) mixed with feed twice a day. Horses were treated for 60 days and then subjected to a alternating feed-deprivation period to induce or worsen ulcers. Gastroscopy was performed on each horse before each treatment period (day 0), on day 30, day 60, and following the alternating feed-deprivation period (day 67). Gastric juice was aspirated and pH was recorded along with overall NG gastric ulcer score, NG ulcer severity score, and NG ulcer number score. Between each treatment period the horses had a 4-week washout period. All horses received the two treatments. The data was analyzed using a cross over ANOVA model with significant differences considered, $P < 0.05$.

Mean overall NG gastric ulcer score decreased on Day 30 in both groups compared to ulcer scores on Day 0, whereas ulcer scores increased on Day 60 in the SBC-treated group, compared to the control group. However, on Day 67 after the alternating feed-deprivation period, overall NG gastric ulcer score increased in the control group from 1.1 to 2.0, whereas the mean gastric ulcer score in the SBC-treated group remained the same. Mean NG ulcer number and severity decreased in both groups on Day 30, compared to Day 0 and in-

creased on Day 60 in both groups. However, after the feed-deprivation period, mean NG ulcer number and severity stayed the same for the SBC-treated group, while the mean NG number and severity scores increased in the control group. The SBC did not effect the acidic environment of the stomach, as mean gastric juice pH was 2.32(±.24) in the SBC-treated group compared to 2.25(±.26) in the control group. During, the feed-deprivation period, ulcer scores improved or stayed the same in 7/8 (88%) SBC-treated horses, compared to 2/8 (25%) of the control horses.

While trends were seen, SBC did not significantly decrease NG gastric ulcer score, number, or severity when compared to untreated controls. SBC was not effective in the treatment of NG gastric ulcers in horses in this study, but trends showed it aided in preventing worsening of gastric ulcers during the feed-deprivation period. Thus, SeaBuck™ Complete Liquid may aid in the prevention of gastric ulcers during stress without altering normal stomach pH.

ВЛИЯНИЕ ЭКСТРАКТА ОБЛЕПИХИ НА ЛЕЧЕНИЕ И ПРОФИЛАКТИКУ ЯЗВЫ ЖЕЛУДКА ЛОШАДЕЙ

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Проведена оценка эффективности экстракта облепихи (SeaBuck™ Complete Liquid) при лечении и профилактике язвы желудка у лошадей. На фоне отсутствия очевидного оздоровительного эффекта, установлена достоверная профилактическая значимость препарата.

PROTECTIVE AND THERAPEUTIC POTENTIALS OF SEABUCKTHORN

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In the recent years, clinical importance of herbal drugs has received considerable attention worldwide. It has been now well recognized that plants growing under extremes of environmental conditions can develop mechanisms or biomolecules which can facilitate their adaptation to the environmental vagaries besides enhancing resistance to the stressful stimuli. The biomolecules synthesized by these plants have significant healing properties and can be developed into noble drugs or formulations against wide spectra of diseases.

Seabuckthorn (*Hippophae rhamnoides* L.) the thorny nitrogen fixing deciduous shrub native to Europe and Asia has drawn considerable attention as a promising plant rich in a variety of molecules having established medicinal and nutraceutical activity. This plant is able to grow in the cold desert regions of Himalayas under hypoxic environment and is extensively used by the high altitude natives for a variety of ailments. All parts of the plant are considered to be a good source of a large number of bioactive substances like vitamin A, C, E, K, carotenoids, flavonoids, phytosterols, organic acids and unique combination of some of the rare antioxidants having significant medicinal effects. Infact, many of the seabuckthorn (SBT) based preparations have been claimed to be effective against flu, cardiovascular diseases, mucosal injuries and skin disorders by traditional healers.

However, most of the studies on medicinal uses of seabuckthorn have been carried out using seabuckthorn fruit or seed oil and attempts have not been made to study the medicinal value of seabuckthorn leaves which are a rich source of unique combination of phytosterols, flavonoids and antioxidants. We have carried out a large number of investigations both *in vitro* using rat splenocytes, murine macrophages, human lymphocytes, C6 glioma cells and also *in vivo* in experimental animals using seabuckthorn leaf extract and seed oil. The seabuckthorn leaf extract was found to have significant cytoprotective, immunomodulatory, antioxidant and anti-inflammatory

activity. The SBT leaf extract alone stimulated IL-2 and r-IFN production but did not alter IL-4 secretion suggesting that SBT leaf extract specifically activates the cell mediated immune response. The leaf extract was also found to have significant wound healing activity when tested in incision wound model and was found to stimulate protein, hydroxyproline and DNA synthesis besides activating angiogenesis. The leaf extract also has significant hepato-protective activity when tested against CCl₄ induced acute hepatotoxicity in rats. When administered before exposure to hypobaric hypoxia both leaf extract and seed oil were found to have significant adaptogenic activity and enhanced hypoxic tolerance by inhibiting hypoxia induced transvascular fluid leakage in the rat lungs and brain. The leaf extract was able to curtail hypoxia induced single strand DNA breaks in C6-glioma cells and restored mitochondrial integrity suggesting that SBT leaves have significant neuroprotective activity under hypoxic environment. The seed oil and leaf extract were found to have significant vaso-relaxant activity when tested in aortic ring model using polygraphic recording system. The seed oil was also found to have significant antiatherogenic and cardioprotective activity when evaluated in hypercholesteremic rabbits. These observations suggest that the seabuckthorn leaf extract and seed oil can be developed as plant drugs or nutraceuticals against a variety of diseases.

ЛЕЧЕБНО-ПРОФИЛАКТИЧЕСКИЙ ПОТЕНЦИАЛ ОБЛЕПИХИ

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Индия

Показано значение облепихи как источника ценных биологически-активных соединений, имеющих терапевтическую направленность. В работе сделан акцент на исследования потенциала использования листьев и семян облепихи в лечебных целях. Показан широкий спектр лечебно-профилактической активности экстракта листьев облепихи, а также масла, полученного из семян этой культуры.

PROPHYLACTIC EFFICACY OF SEABUCKTHORN OIL VIS-A-VIS OTHER GASTROPROTECTIVE AGENTS AGAINST GASTRIC ULCERATIONS AND EROSIONS

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The prevention of the gastric ulcerations and erosions (GUE) or at least minimizing its severity is a challenging task during long term anti-inflammatory therapy in animals as well as in humans. The various drugs available in the market show variable efficacy and also have undesirable side effects. Seabuckthorn oil (*Hippophae rhamnoides*) has shown good gastro-protective activities in rats in some studies. In the present study Seabuckthorn seed oil was compared with three commonly used ulcer medicines “Omeprazole”, “Sucralfate” and “Magnesium-Aluminum hydroxide gel” for the prevention of steroidal anti-inflammatory drug induced GUE in dogs. The study was conducted on 24 healthy dogs divided in to six equal groups. Inj Dexamethasone @1 mg/kg was administered I/M or I/V s.i.d in all dogs for 16 days to induce GUE. Group I was kept as untreated control whereas, Seabuckthorn oil @ 5ml/dog b.i.d., Omeprazole @ 0.7 mg/kg s.i.d., Omeprazole @ 1.5 mg/kg s.i.d., Sucralfate @ 1gm/dog b.i.d. and “Magnesium-Aluminum hydroxide gel” @ 10ml/dog b.i.d. were orally administered in group II, III, IV, V and VI respectively. The severity of GUE was analyzed on the basis of clinical, haematological and endoscopic examinations. Only groups II and VI treated with seabuckthorn oil and Magnesium-Aluminum hydroxide gel respectively showed appreciable lesser intensity of GUE in the initial period of study up to 10 days. On comparative basis, the GUE intensity was lesser in group II. The results indicate that Seabuckthorn oil has better prophylactic efficacy against development of GUE in dogs than routinely used ulcer medicines.

Key words: seabuckthorn, omeprazole, sucralfate, magnesium hydroxide, aluminum hydroxide, gastric ulcer, prevention, dog

**ПРОФИЛАКТИЧЕСКАЯ АКТИВНОСТЬ
ОБЛЕПИХОВОГО МАСЛА ПО СРАВНЕНИЮ
С ДРУГИМИ ПРЕПАРАТАМИ
ДЛЯ ЛЕЧЕНИЯ ЯЗВЕННОЙ БОЛЕЗНИ ЖЕЛУДКА
И РЯДА ДРУГИХ ЯЗВЕННЫХ ПОРАЖЕНИЙ**

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Проведено сравнительное изучение эффективности масла из семян облепихи при лечении ряда язвенных поражений у животных. Установлен более высокий эффект от его применения при профилактике язвенных болезней по сравнению с традиционными препаратами.

**NEW DEVELOPMENTS IN HIPORAMIN
PHARMACEUTICAL FORMS PRODUCTION
AND THEIR SAFETY ESTIMATION STUDY**

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Original antiviral phytodrug Hiporamin produced from *Hippophae rhamnoides* leaves, containing hydrolysable gallo-ellagitannins, possesses antiviral activity in respect of pathogenic RNA and DNA containing viruses (Influenza A and B, Herpes, Adenoviruses, HIV etc. The drug also inhibits gram + and gram - bacteria, Micobacteria tuberculosis, Candida albicans etc. A combination of

various positive properties, as well as chemotherapeutic activity in respect of various infection strains it produces favorable effect on the microorganism with absence of side effects during clinical trials, securing wide range of its therapeutic efficiency. Nowadays six pharmaceutical forms are worked out in Russia for external and internal use (sublingual tablets 0.02, intestine soluble tablets, lyophilized powder 0.02 for preparation of solutions 0.1 – 0.2 % (for inhalations and nasal drops), ointment 0.5% for the skin and mucous membranes, suppositories rectal and vaginal 0.05 for adult and 0.03 for children). Sublingual tablets were used for treatment of Influenza for delivery the medicinal substance directly to blood excluding the gastrointestinal tract and the biliary (liver) barrier. The task of the work was to elaborate the optimal composition of the sublingual tablets with durable action. To-day new modified pharmaceutical soft forms of Hiporamin (gel and 0.5% liniment) at a basis of Arespol had been worked out for treatment and prophylactics Herpes viral infections. Different supplementary substances in various ratio were tested to produce the desired positive effects. A complex physico-chemical, technological, and bio-pharmaceutical methods of study were tested for their standardization and the storage periods determination. Rectal and vaginal suppositories were also elaborated. The methods of the drug identification and the quantitative tannins content determination in soft forms were elaborated.

Drug safety estimation of the soft pharmaceutical forms was realized on the rabbits *Chinchilla* species. The pharmaceutical forms were applied to the skin on the back of the experimental animals once per day within 8 weeks. Rabbits of the control group got applications placebo of the gel and liniment. There was found that the pharmaceutical forms did not produced toxic or irritation effects on the skin of the experimental animals in repeated applications. As a result of the study Hiporamin gel and liniment were recommended for clinical trials.

Key-words: *Hippophae rhamnoides*, pharmaceutical forms, toxicological study

**НОВЫЕ РАЗРАБОТКИ
В ПРОИЗВОДСТВЕ ЛЕКАРСТВЕННЫХ ФОРМ
ГИПОРАМИНА И ОЦЕНКА ИХ БЕЗОПАСНОСТИ**

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Рассмотрен терапевтический эффект от применения различных форм противовирусного препарата Гипорамин, изготовленного из листьев облепихи, содержащий танины. Предложено шесть форм препарата для наружного и внутреннего применения. Проведены физико-химические, технологические и биофармацевтические исследования. Проведена оценка безопасности лекарства в опытах с крысами. Доказано отсутствие токсичного и раздражающего эффекта. Гель и мазь рекомендованы для клинических испытаний.

**THERAPEUTIC EFFICACY OF SEABUCKTHORN OIL
AND GASTROPROTEC IN GASTRIC ULCERATIONS
AND EROSIONS**

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The treatment of gastric ulcerations and erosions (GUE) in animals as well as in humans is difficult. The various drugs available in the market have limited efficacy and undesirable side effects particularly during their prolonged use. Alternative plant based medicines like "Ayurvedic" preparations may have advantages in this regard

due to their different mode of actions. Seabuckthorn (*Hippophae rhamnoides*) is one such useful plant that is known for its gastro-protective activities. In the present study Seabuckthorn seed oil was compared with multicomponent herbal preparation "Gastroprotac" for the treatment of experimentally induced non fatal GUE in dogs. The study was conducted on 16 healthy dogs divided in to four equal groups. GUE were produced in all dogs by administration of Inj Dexamethasone @1 mg/kg s.i.d. I/M or I/V for 16 days. Thereafter, group I was kept as untreated control to evaluate spontaneous healing of GUE whereas other groups were treated with oral administration of seabuckthorn oil @5 ml/dog, Gastroprotac 5 ml/dog and Gastroprotac 10 ml/dog in group II, III and IV respectively twice a day till healing. The healing was evaluated on the basis of clinical, haematological and endoscopic examinations. The group II and group IV treated with seabuckthorn oil and Gastroprotac @10 ml/dog respectively showed better healing response than untreated group. On comparative basis of these two groups, the healing response was better in group IV. The results indicate that combining different herbs may show synergistic actions and therefore better healing efficacy than single herb preparation in GUE.

Key words: seabuckthorn, Gastroprotac, gastric ulcer, dog

ТЕРАПЕВТИЧЕСКИЙ ЭФФЕКТ ОБЛЕПИХОВОГО МАСЛА ПРИ ЛЕЧЕНИИ ЯЗВЫ ЖЕЛУДКА

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Проведено изучение терапевтического эффекта от применения масла, полученного из семян облепихи в комплексе с мультикомпонентным препаратом на растительной основе Гастропротек. Установлено синергетическое действие смеси и рекомендовано их использование при лечении язвенных поражений.

DRUG DISCOVERY THROUGH SEABUCKTHORN RESEARCH

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Our earlier work on Indian species of seabuckthorn (SBT), (*Hippophae rhamnoides*) led to the isolation and characterization of the nutraceutically important compounds such as fatty acids and their derivatives, carotenoids, vitamins, triterpenoids, steroids etc. In addition to nutraceuticals, SBT products contain compounds which show activities of pharmaceutical interests. Our recent investigations are directed towards isolation and characterization of high value compounds from leaves and other parts of SBT. Because of the chemodiversity, diverse methodologies for the isolation of SBT constituents were utilized. Both polar and non-polar constituents were investigated. Our recent work on polyphenolics of SBT will be presented. Extraction was carried out using conventional (extraction with solvent/solvent mixtures, complexing with designer ligands or macrobiomolecules. Recent techniques such as high-pressure extraction, super-critical extraction using designer solvent mixtures were also used. Mild methods of extraction were useful to avoid possible decomposition of labile molecules. Partition and molecular exclusion chromatography were used for the isolation of compounds. Compounds were characterized by chemical reactions as well as instrumental methods (UV, IR, MALDI, NMR). Compounds or extracts were studied for wound healing, antioxidant activities. The bioactivity of isolated products or extracts will be discussed.

Key words: *Hippophae rhamnoides*, polyphenols, glycosides, molecular characterization.

ПОИСК ЛЕКАРСТВЕННЫХ СРЕДСТВ ЧЕРЕЗ ИЗУЧЕНИЕ ОБЛЕПИХИ

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Обсуждаются результаты экстракции биологически активных соединений облепихи различными современными способами. Представлены количественные характеристики компонентного состава плодов, листьев и других частей растений облепихи. Приведены результаты изучения ранозаживляющей и антиоксидантной активности выделенных экстрактов.

MODULATING COGNITIVE PERFORMANCE THROUGH NUTRITIONAL OR/AND PSYCHOLOGICAL INTERVENTIONS IN THE POPULATION WITH PRE DISPOSITION TO COGNITIVE IMPAIRMENT

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Environmental toxins/ stress factors, vitamin deficiencies and ageing process, all can alter cognition, in which neural cells succumb to neurodegeneration. The latest research findings suggest that any type of cells that are lost in the body, including the neurons, can be replaced; provided the nutritional and hormonal environment of the neural cell is restored to normal (Dubey *et al*, 2008). Therefore, appropriate nutritional interventions may be useful as prophylactics and are likely to help in proper management of Cognitive decline.

Antioxidant supplements have been reported to help in stabilization and management of these disorders. Use of vitamin E and vitamin C supplements in combination also helps. There appears to be a link between antioxidant intake and cognitive decline. Vitamin-C, Beta Carotene and Vitamin E supplementation have been reported to accelerate learning and to prevent the memory deficits associated

with oxidative stress. Similarly high intake of mono-unsaturated fatty acids (MUFA) and caffeine have also been associated with protection against the cognitive decline (Dubey *et al*, 2008).

Plant based nutraceuticals are emerging as strong candidates for prophylaxis and management of neurodegenerative disorders. High Altitude plant Seabuckthorn is a treasure house of these Vitamins, a number of antioxidant constituents and MUFA, which can provide a great prophylactic option to prevent MCI and other major Neurodegenerative disorders to troops and tourist staying in High Altitude Areas (Attrey, 2003, 2004 and 2007; Dwivedi and Attrey *et al*, 2002 (2 patents, including one on Leh Berry Juice and a paper in 2002; Arumagham & Attrey *et al*, 2004; Agrawal and Attrey *et al*, 2004 and 2006). Market is, however, full of nutraceuticals, food supplements and therapeutics (both traditional and allopathic) which claim to prevent and manage neurodegenerative disorders. But scientific evidence of efficacy and safety of most of these, for the management of neurodegenerative disorders, are still debatable and public confidence in these products is not high. Hence, there is a dire need for development of an effective and economical nutritional intervention for prevention of MCI in the predisposed personnel and also for its management, in the cases which have already been affected. The present paper provides the preliminary evidence that the high altitude plant Seabuckthorn has the necessary bioactive components to prevent cognitive decline.

ИЗМЕНЕНИЕ ПОКАЗАТЕЛЕЙ СПОСОБНОСТИ К ПОЗНАВАТЕЛЬНОЙ ДЕЯТЕЛЬНОСТИ ЧЕРЕЗ ПИТАНИЕ ЛИБО ФИЗИОЛОГИЧЕСКОЕ ВМЕШАТЕЛЬСТВО У НАСЕЛЕНИЯ С УХУДШЕННОЙ ФУНКЦИЕЙ ВОСПРИЯТИЯ

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Показано значение облепихи, как источника биоактивных компонентов, способствующих лечению и профилактике нервных расстройств.

EFFECTS OF SEABUCKTHORN FLAVONOIDS ORAL LIQUID ON 26 PATIENTS WITH SEQUELAE OF STROKE

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Seabuckthorn Flavonoids Oral Liquid, Hyperlipidemia prevention health food that developed by the author with fresh sea buckthorn pulp as the main active ingredient, was launched in the market in 1996 for patients with sequelae of stroke. The 10-year follow up study of 26 cases of patients with sequelae of stroke showed that 26 cases of deformity were improved in varying degrees, including basic rehabilitation in 2 cases, significant improvement in 18 cases, and moderate improvement in 6 cases. Among 5 cases of patients presented with aphasia, significant and moderate improvement were observed in 2 and 3 cases, respectively. Two cases of patients with aphagia achieved rehabilitation. Two cases of patients with urine incontinence restored the normal function. Our observation studies show that Seabuckthorn Flavonoids Oral Liquid plays a significant role in facilitating the rehabilitation of sequelae of stroke. Our study indicates that bioactive ingredient of seabuckthorn may cross the blood-brain barrier and contribute to the treatment of diseases in brain. Therefore, more in-depth research in academia and pharmaceutical industry is worthwhile and needed to promote the usage of seabuckthorn.

Key words: Seabuckthorn Flavonoids Oral Liquid; Hyperlipidemia; Stroke Sequelae; blood-brain barrier, Stroke Prevention

**ТЕРАПЕВТИЧЕСКИЙ ЭФФЕКТ
ОТ ПРИМЕНЕНИЯ ВНУТРЬ РАСТВОРА ФЛАВОНОИДОВ
ПРИ ЛЕЧЕНИИ ОСЛОЖНЕНИЙ ПОСЛЕ ИНСУЛЬТА**

Яншенг Зоу

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Приведены результаты 10-летних исследований по изучению лечебного эффекта жидкого раствора флавоноидов, полученных их облепихи, на пациентах с осложнениями после инсульта. Обсуждаются результаты применения препарата на разных группах пациентов с заболеваниями нервной системы.

IMMUNOMODULATION BY DIETARY SEABUCKTHORN

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The incorporation of medicinal herbs in various medicaments has been the hall mark of Indian traditional health care system. The herbs are being used since antiquity on the empirical basis. Therefore, there is immense need of pharmacological and scientific validation of the folklore claims of various herbal medicaments. Seabuckthorn has a long history of its usage in various Indian and Chinese health care systems. Many of its therapeutic used such as anti-atherosclerotic, antiarrhythmic, hepato-protective, skin protective anti

ulcerogenic actions have been vividly described. In this paper immunomodulatory actions of dietary seabuckthorn are described. The immunodulation was assessed on the basis of humoral, cellular and non specific immunity parameters.

White albino rats were fed dietary levels of 200, 400 and 800 ppm of powdered berries of seabuckthorn over a period of 2 months (56 days). There was significant increase in total serum protein and serum globulin and A:G ratio . A significant increase ($P < 0.05$) was observed in the haemagglutination titres at 800 ppm on day 42 of feeding. The macrophage function was significantly increased in rats fed 400 and 800 ppm in a dose dependent manner. The delayed hypersensitivity reaction to DNFB was found to be significantly higher ($P < 0.05$) at 48 and 72 h in rats fed 800 ppm. The histopathology of lymph node and spleen revealed a marked increase in B cell activity.

In poultry birds dietary levels of 500 and 1000 ppm of seabuckthorn berries were fed in ration for a period of 62 days. Seabuckthorn did not influence the growth of the poultry birds at the given dietary levels. Seabuckthorn fed birds had higher A: G ratio in seabuckthorn fed birds at both the dietary levels. Significantly higher ($P < 0.05$) HI titres against NCD virus and NBT positive cells (indicating macrophage function) were also observed at both the dietary levels .A significantly higher delayed hypersensitivity reaction to DNFB was also observed in seabuckthorn fed birds. A significant lymphocytosis was observed in birds fed seabuckthorn at 1000 ppm dietary levels. The weight of spleen, bursa and thymus were higher ($P < 0.05$) in seabuckthorn fed animals. Histopathology of the skin of seabuckthorn fed birds showed sloughing of epidermis, formation of erosive and ulcerative lesions and infiltration of mononuclear cells apart from lymphofollicular reactions. The experimental studies have, thus, indicated stimulation of immune response following dietary intake.

Key words: Immunomodulation , seabuckthorn

ВЛИЯНИЕ КОБЛЕПИХОВОЙ ДИЕТЫ НА ИММУННУЮ СИСТЕМУ ЖИВОТНЫХ

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Представлены результаты изучения иммуномодулирующего эффекта от применения облепиховой диеты на мышах альбиносах, а также на домашней птице. Оценены гуморальные, клеточные и неспецифичные иммунные параметры. Показано существенное влияние кормления облепихой на стимуляцию иммунной системы у экспериментальных животных.

PREVENTIVE EFFECT OF SEABUCKTHORN ZHI KANG MIXTURE ON EXOGENOUS HYPERLIPIDEMIA IN A RABBIT MODEL

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Seabuckthorn Zhi Kang Mixture, in which fresh Seabuckthorn pulp is the main active ingredient, is approved for clinical use from the State Drug Administration [2004L04332]. Preventive role of Seabuckthorn Zhi Kang Mixture on a rabbit exogenous hyperlipidemia model was observed. Continuous administration of Seabuckthorn Zhi Kang Mixture for 8 weeks significantly reduced Serum Total Cholesterol ($P<0.05$), Triglyceride ($P<0.01$) and Low-density lipoprotein cholesterol ($P<0.05$). Serum high density lipoprotein cholesterol was increased ($P<0.01$). In addition, our study showed that Seabuckthorn Zhi Kang Mixture had preventive effects on atherosclerosis.

Key words: Fresh Seabuckthorn Pulp; Hyperlipidemia; Atherosclerosis

**ПРОФИЛАКТИЧЕСКИЙ ЭФФЕКТ
ПРЕПАРАТА «СМЕСЬ ЖИ КАНГ»
ПРИ ЛЕЧЕНИИ ЭКЗОГЕННОЙ ГИПЕРЛИПИДЕМИИ
В ЭКСПЕРИМЕНТАХ С КРОЛИКАМИ**

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Представлены результаты клинических испытаний препарата «Смесь Жи Канг», зарегистрированного Государственным комитетом по фармакологии, основой которого является мякоть плодов облепихи, при лечении экзогенной гиперлипидемии. На фоне заметного снижения общего холестерина и триглицеридов в сыворотке, способствующих профилактике изучаемой болезни, препарат также хорошо себя проявил и при лечении атеросклероза.

MISCELLANEOUS

PA3HOE

SEABUCKTHORNOLOGY A NEW INTERDISCIPLINARY SCIENCE AND ITS NECESSARY TERMINOLOGY

Angel Proorocu

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In Proceeding of the first Congress of International Sea buckthorn Association are essays elaborated by specialists from Bolivia, Canada, China, Estonia, Finland, Germany, India, Italy, Latvia, Romania, Russia and Ukraine. At the second Congress I, a Romanian agronomist, was honored to meet delegates from Azerbaijan, Bolivia, Canada, Korea, Finland, Germany, India, Italy, Japan, Latvia, Mongolia, Nepal, Nigeria, Pakistan, Russia, Sweden, Turkey, Ukraine and U.S.A.

There were specialists from many countries under one flag, sea buckthorn a plant which means hundreds of year of plant arrangement architecture, research, experience, secrets, production, health of soil, health of animals and health of peoples in a self-destructive human society of the third millennium.

What displeased at those Conferences? The impossibility of put in orders all important and multidisciplinary information.

There were involved specialists in: botanic, geology, marketing, medicine, biochemistry, agronomy, management etc. All of them need information. The solution is to be elaborating a statute of an interdisciplinary new science the subject being sea buckthorn and the most important, a multilingual data base alphabetically ordered accessible for anyone interested.

I obtained the title of doctor in agricultural sciences with Doctorate Thesis “Studies about the importance of *Hippophae rhamnoides L.* for the environment and the economy of human health”. The actuality of my thesis and the mondial situation make me to be honored to present my theory at the conference.

In this case if we will consider a new scientific domain, the last congresses justified this, seabuckthornology, we will be able to delimitate the domain’s terminology.

The most important aspect is the permanent actualization of data base, in a moment a Chinese enterpriser for example who 100 tones of sea buckthorn oil needs will can find many offers from the entire world, obtaining all parameters and prices in few minutes, the address, fax, e-mail, phone number etc.

In actual world crise a scientific abordation of seabuckthorn may be a solution in health and envinronmenthal problems.

Key words: seabuckthornology, viticulture, terminology, land improvements, remedy, cure, Romanian contribution, scientific and commercial information.

**ОБЛЕПИХОЛОГИЯ –
НОВАЯ МЕЖДИСЦИПЛИНАРНАЯ НАУКА,
НЕОБХОДИМОСТЬ СОВЕРШЕНСТВОВАНИЯ
ТЕРМИНОЛОГИИ**

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Обозначена необходимость разработки нового направления в исследованиях по облепихе – так называемой облепихологии, важнейшей задачей которой должно стать постоянное накопление знаний и баз данных по облепихе. Определено значение унифицированной терминологии.

SEA BUCKTHORN PROJECT PRESENTATION

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Our Mongolian private companies group GANGAR cultivates Mongolian native plant sea buckthorn since 1999. The main activity of the group is planting, projecting, financing, construction and selling of residential houses as well carries out production of some constructing materials and importation of constructing materials. The group constructed and sold up to present time over three thousand apartments and completing now additional 600.

We have a sea buckthorn garden with 36 thousand sea buckthorn trees four to seven years old. We rely to several decades' experiences of Russia, Europe, China and our country. We are working for long time aims in accordance with our plans. We have own nursery with annual capacity of 500 thousand young trees, which are enough for planting at 400 hectares.

Our company Kharkhorin Joint Stock Company is located in somon (community) Kharkhorin of Öwörkhangaï Aimag (province), which is located 120 kilometres from province centre Arwaikheer, 360 kilometres from Ulaanbaatar in the Valley of Orkhon River. Here has been ancient Mongolian capital Karakorum.

Our prior aim is to create until 2012 our own commercial orchard at 2.7 thousand hectares. We have there irrigated fields with three thousand hectares area. Under Mongolian conditions cultivation of sea buckthorn requires irrigation. Orchard to be created will not use any chemical fertilizer, pesticides and herbicides. We chose site for orchard under considering avoiding any possible pollution. In our sea buckthorn commercial orchard will produce ecological pure products. We planted already sea buckthorn at about one thousand hectares from planned 2.7 thousand hectares. At this way we shall harvest from 2013 each year 18 thousand metric tons of sea buckthorn berries with Mongolian market value of 36 million US dollars. After completing of these works we shall create 2.5 to 3 thousand new jobs, about 400 of them for skilled professionals.

Thereafter we plan to create a plant for processing of sea buckthorn berries. From 2017 the orchard will provide full harvest or

19,000 metric tons berries. The market value of that quantity amounts 39,520,000 US dollar. Beside of this our nursery will provide annually two millions young trees with market value of 2,840,000 US dollar.

We have invested until the present time about 20 million US dollar. For realization of this project we shall spend additional investments of 10.7 million US dollar (excluding working capital). Other investments no less than 20 million US dollar will be required for creation of processing plant. We plan to cover our investments by profits within 1.9 years after reaching full capacity. We are ready to prove proposals for co-operation, which should be mutual, advantageous for both partners.

ПРОЕКТ «ОБЛЕПИХА»

Пурев, Суренджав

Гангар инвест Со. Ltd., Монголия

Представлен проект закладки масштабных облепиховых плантаций в Монголии с объемами производства к 2017 году до 19 тыс. тонн экологически чистых плодов облепихи.

DEVELOPMENT OF INTERNATIONAL CO-OPERATION ON SEA BUCKTHORN RESEARCH: ROLE OF ISA, EXPERIENCE AND PROSPECTS

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The paper deals with international cooperation on sea buckthorn, significance of ISA in this process, our experience and future prospects.

International Sea Buckthorn Association and its Scientific Committee were established in order to fast the step of international sea buckthorn scientific research in different fields. Regular ISA

meetings play significant role in this process, helping people from research, technology and business in distributing their knowledge on sea buckthorn and give them possibility to get acquaintance with each other.

EAN-SEABUCK project (2005- 2007) was our first experience in international cooperation on sea buckthorn financed by EU (FP 6). The project justified our expectations and as the results bridge between Europe and Asia was built, network with experts in different areas of research was developed and new experience and knowledge were received.

Canadian-Russian project in the frame of “Partnerships for Tomorrow Program Phase II”. The project (July 2008) was based on the mutual interest of Canadian and Russian counterparts expressed during ISA conference held in Quebec City in 2007. Three institutions took part in that project: Food Development Centre (Canada, Manitoba) Northern Research Institute of Forestry (Russia, Arkhangelsk) and All Russian Research Institute of Medical and Aromatic Plants (Russia, Moscow). The project linked Russian scientists with Canadian researchers in similar or related areas for partnership development; strengthened professional capability and capacity of participating institutes; increased knowledge of sea buckthorn and its commercial potential.

One of the aim of the new international FORESTSPECS project (2009-2011), financed by European Commission (FP 7), is to utilize different types of large-volume wood waste, e.g. bark, sawdust and chipped wood from the pulp and paper industry, as organic fertilizers e.g in the cultivation of sea buckthorn plantations. There is a need to develop composting based on the wood-related residues, to define their influence on the main indicators of soil fertility, the yield of fruit-berry plants, and the quality of plant production in the Northern Region of Russia.

In order to strengthen international cooperation in the knowledge sector, the ISA need to work out a joint research programme in areas of mutual interests defined in priorities given by the ISA side. The mutual interests should be realized through joint funding and programme management.

Key words: sea buckthorn, international cooperation, ISA.

**РАЗВИТИЕ МЕЖДУНАРОДНОГО
СОТРУДНИЧЕСТВА ПО ОБЛЕПИХЕ:
ЗНАЧЕНИЕ МЕЖДУНАРОДНОЙ АССОЦИАЦИИ
ПО ОБЛЕПИХЕ, ОПЫТ И ПЕРСПЕКТИВЫ**

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В материале представлены наиболее заметные международные проекты в области исследований по облепихе, такие как EAN-SEABUCK, FORESTSPECS и другие. Раскрывается роль Международной ассоциации по облепихе как координатора этих исследований.

**WWW.EANSEABUCK.COM
FUTURE DEVELOPMENT OF THE PROJECT WEBSITE
AS AN INTERNATIONAL WEB BASED COMMUNICATION,
INFORMATION AND BUSINESS PLATFORM**

Axel Waehling

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One aim of the EAN-SEABUCK project funded by the European Commission was the establishment of an integral cooperation network between Europe and Asia for the joint sustainable utilisation of seabuckthorn. The main focus was lying on Russia including NIS countries, China and the European countries.

As a result of that project the information platform - www.eanseabuck.com- was created. After registration, everybody

can download documents from this website free of costs. Since September 2008 NIG is the owner of the website and hold all rights. The international interest in seabuckthorn is documented by 2 to 5 registrations per week. At the moment some gaps still exist with registrants from Russia and China due to language problems. In the future NIG plans to develop the eanseabuck website as the world leading web based information, communication and business platform for B2C and B2B applications. The platform will be provided the services in English, Russian, Chinese and German language and will be open for interested persons and companies worldwide dealing with seabuckthorn.

The presentation will inform about services as well as possibilities for persons and companies using the platform as customer or partner. Due to the supply of scientific and technological knowledge and the combination with common business platform the presenters expect a win-win situation for shared partners and seabuckthorn in general.

Key words: seabuckthorn, marketing

**РАЗВИТИЕ ПРОЕКТА WWW.EANSEABUCK.COM,
КАК МЕЖДУНАРОДНОЙ ИНТЕРНЕТ ПЛАТФОРМЫ
ПО ОБЛЕПИХЕ В СФЕРЕ КОММУНИКАЦИЙ,
ИНФОРМАЦИИ И БИЗНЕСА**

Аксель Велинг

NIG, Магдебург, Германия

Обоснована необходимость создания и поддержания, задачи и возможности международной Интернет-платформы по облепихе.

SEA-BUCKTHORN AS A NEW IMAGE-MAKING FACTOR OF THE ALTAI TERRITORY

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The “Image” topic of the territories is especially popular today in Russia. And that is natural because the image of a region has an active influence on the market condition and the increase of the investment and cultural attraction of one or another place. Therefore it is obvious that the image of the region not only has to be formed but be constantly developed and supported.

The Altai territory already has a certain image based on the natural resources. The today’s administration presses towards the strengthening of this image by turning the territory into a strong region with developed tourism, profitable agrarian branch and innovation industry. Among the image-making factors of the Altai territory there are Altai honey and cheeses, hard wheat, products of maral breeding and the unique Biriuzovaya Katun. However it is far from everything of what Altai can be proud. So, for example, in our opinion, the topic of sea-buckthorn is not being enough popularized despite the fact that the Altai territory is extraordinary rich in this berry. It is the achievements of the scientists from the Lisavenko Research Institute that make our region the recognized world leader in the selection of new sorts of sea-buckthorn. But the truth is that it is known only in the specific circles. In our opinion, it is necessary today to provide society with this information, forming in that way the sea-buckthorn brand of Altai.

A brand is the name which is associated by the potential buyer with something needed and useful. Health and beauty are the main needs of a modern person and the sea-buckthorn is a unique specimen which is an excellent stuff for producing health-improving

products. The sea-buckthorn which has been a perfect Altai brand for years has been produced in the region already for a long time. However it is produced not only in our region that is why new daring products which were not produced before are needed.

Today we have already arranged in the region the production of such innovative products as sea-buckthorn and honey nectar “Olymp”, 10 sorts of sea-buckthorn desserts “Vitamix”, developed by the scientific department of the production firm “Altai Bouquet” together with the scientists of the product technologies department of the Altai State Technical University (M.Shchetinin - head of the department). A huge amount of work has been done. Starting from the organization of the right storage of the fresh berries and finishing with the arrangement of modern ways of processing which include sparing pasteurization (which preserve the vitamins) and cavitation method of the berry treatment. For the nearest future the company “Altai bouquet” is planning the production of a whole series of more than 50 sea-buckthorn products such as sea-buckthorn syrup, tea, jelly, cakes. This series of products for health and beauty made of the Altai sea-buckthorn already has the name – “The orange sun of Altai”. This is the name of a new brand, a new category, an important component of the successful brand advertising. The main thing is still to be done – to attract attention of the community to the new concept, to explain clearly and popular to the customers the advantages of the products produced according to this concept. A well-planned PR-campaign and the warm and honest support from the press are needed for this. All stakeholders must participate in the process of advertising.

The revolutionary concept, the increased attention of the press and the recent statement of our governor that the Altai territory has “a secret weapon in the struggle for the Olympic victories” – in our opinion all this will contribute to the quick promotion of the sea-buckthorn brand of Altai.

ОБЛЕПИХА КАК НОВОЕ ИМИДЖЕВОЕ НАПРАВЛЕНИЕ ДЛЯ АЛТАЙСКОГО КРАЯ

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Показан социально значимый аспект облепихи, как имиджевой культуры для Алтайского края. Раскрыта необходимость производства как можно большего числа продуктов на ее основе. Представлены первые наработки в линейке продуктов функционального питания. Обоснованы способы продвижения продуктов на рынке.

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SCIENCE AND INDUSTRY INTERACTION**

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**ОБЛЕПИХА – НА ПУТИ ОБЪЕДИНЕНИЯ
НАУКИ И ПРОИЗВОДСТВА**

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