



The Annual Report of International Seabuckthorn Development for the Year of 2021 国际沙棘发展报告 (2021 年度)

International Seabuckthorn Association (ISA)
Management Center for Seabuckthorn Development
Ministry of Water Resources, CHINA
In December of 2022

国际沙棘协会
水利部沙棘开发管理中心
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Preface

Seabuckthorn is a multi-purposes plant known as *Hippophae* in Latin name, Seabuckthorn in English, Shaji in Chinese, Облепиха in Russian, Sanddorn in German, Argousier in French, Espina de Mar in Spanish, Tyrni in Finnish, Havtorn in Swedish and Tsestallu/Charma/Bardiphal in India respectively.

International Seabuckthorn Association (ISA) with the Headquarter in Beijing, China, is an academic and industry-based international non-governmental and non-profit organization that is voluntarily formed by enterprises, institutions, individuals and other organizations which are active in the research and development of seabuckthorn around the world. The purpose of the ISA is to give full play to the role of seabuckthorn in facilitating environmental protection, economic development and human health, promote exchanges and global cooperation in seabuckthorn cultivation, scientific research, production, economy and trade, personnel, information, etc., and provide international communication service of seabuckthorn to ISA members and all sectors of the society.

ISA has the following scope of activities:

1. Give play to the self-discipline role of the seabuckthorn industry, formulate industry regulations, standardize industry behaviors, and promote the development of the industry;
2. Investigate and research the developmental dynamics and trends of seabuckthorn at home and abroad, and provide consulting services for the construction and development of seabuckthorn;
3. Undertake international exchange and cooperation projects entrusted or funded by government agencies and other organizations;
4. Build international seabuckthorn information network and database, and promote international exchanges and cooperation of seabuckthorn;
5. In accordance with relevant provisions, edit and publish professional



publications, and expand the popularity and publicity of seabuckthorn knowledge;

6. Organize and host exchange activities such as seabuckthorn academic seminars at home and abroad;

7. Carry out personnel training and exchange visits in the field of seabuckthorn.

For the purpose of information exchange, data sharing among member countries and to improve attraction globally, it is the responsibility and work plan of ISA Secretariat to publish The Annual Report of International Seabuckthorn Development. We fully understand that Country Report of Seabuckthorn Development in the Year of 2021 is the important basic materials. The members of Board/Scientific Committee of ISA are requested to provide with the following national-wide statistical information in 7 aspects listed in Appendix as in detail as possible. And then kindly submit the document in English and/or in Chinese to Mr. Zhang Bin, Deputy Secretary General of ISA, by email of isazhangbin@qq.com.

By the October of 2022, we have received the Country Report of China, Finland, France, India and Latvia respectively. All these reports have been translated into Chinese or English for further bilingual printing with assistances from the Board and Scientific Committee of ISA.

According to the uncompleted statistics, by the end of 2021, seabuckthorn was found in 52 countries. The global resource was around 2,403,000 ha, including 2,141,000 ha in China.

We are looking forward to the better ISA operation and global seabuckthorn development.

The Editing Committee



序 言

沙棘是一种广泛分布在欧亚大陆温带地区的多功能植物资源，在中国西北、华北地区又名：醋柳、酸刺、黑刺、酸溜溜、圪针。其拉丁文: *Hippophae*，英语: Seabuckthorn，俄语: Облепиха，德语: Sanddorn，法语: Argousier，西班牙语: Espina de Mar，芬兰语: Tyrni，瑞典语: Havtorn。在印度不同地区分别称为: Tsestallu, Chharma, Bardiphal。

国际沙棘协会于1999年由中国水利部沙棘开发管理中心联合世界各国沙棘专家共同发起，在2001年印度会议上同意成立。2011年9月，经国务院批准、民政部注册登记，成为第27家总部设在中国的国际组织，其业务主管单位为中华人民共和国水利部。协会由会员代表大会、理事会、专业委员会、秘书处四级组织管理机构组成，秘书处挂靠在沙棘中心。协会理事会成员由全球主要沙棘国家的代表组成，技术委员会成员由世界各国的知名沙棘专家组成。

协会的目标和宗旨是全面发挥沙棘在促进环境保护、经济发展及人类健康等方面的作用，推进中国与世界各国在沙棘种植、科研、生产、经贸以及人员和信息等方面的交流与合作，为会员和社会各界提供沙棘领域的国际交流服务。

协会主要任务是：

- 一、发挥沙棘行业自律作用，制定行业规章，规范行业行为，推动行业发展；
- 二、调查研究国内外沙棘发展动态和趋势，提供沙棘建设与开发咨询服务，组织举办全国性、国际性学术会议；
- 三、承办政府机构等组织委托或资助的国际交流与合作项目，组织举办沙棘专业技术培训和专题考察；
- 四、建设国际沙棘信息网络和资料库，促进国际沙棘交流与合作；

五、编辑出版专业刊物，加大沙棘知识的普及和宣传力度。

为加强国际沙棘协会各成员之间的信息交流，分享世界各国沙棘发展成功经验，国际沙棘协会秘书处成立了《国际沙棘发展报告》专门工作组，组织邀请了国际知名沙棘专家撰写其所在国家的2021年度沙棘发展报告。截止2022年10月，我们收到来自中国、芬兰、法国、印度和拉脱维亚等5个国家的报告并组织翻译成中文（或英文）。现将上述5个国家的报告汇编成《国际沙棘发展报告》，用中英文双语出版。

据不完全统计，截止2021年底，沙棘植物分布在全球52个国家，总面积约2,403,000公顷（约合3605万亩）。其中，中国约2,141,000公顷（约合3212万亩），其他国家约262,000公顷（约合393万亩）。

今后，国际沙棘协会秘书处将继续收集更多国家的沙棘最新进展，于每年10月前编辑上一年度的《国际沙棘发展报告》。

祝愿国际沙棘协会及全球沙棘事业更好更快发展！

《国际沙棘发展报告》编委会
2022年12月

Appendix:

The Recommended Format/Framework for ISA Member Country Report of Seabuckthorn Development in the Year of 2021

1. The national-wide seabuckthorn resources of plantations and berry yield.

1.1. The total area of seabuckthorn resources up to the year of 2021 including the natural stands and the artificial plantations, and the increased areas in the year of 2021.

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6. 当年本国有关沙棘的主要政策文件、发表的研究论文等。

1. Country Report of China



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Seabuckthorn Development in China in the Year of 2021

2021 年中国的沙棘发展报告

Management Center for Seabuckthorn Development, Ministry of Water Resource
Secretariat of International Seabuckthorn Association (ISA)

水利部沙棘开发管理中心
国际沙棘协会秘书处

1. The national-wide seabuckthorn resources of plantations and berry yield, e.g. the total area of seabuckthorn resources up to the year of 2021 including the natural stands and the artificial plantations, and the increased areas in the year of 2021 and the harvested and the estimated qualities of total production of seabuckthorn berries in the country in the year of 2021.

China has the richest and largest area of seabuckthorn natural stands and artificial plantation. By the year of 2021, there were nationally in total 2,141,000 ha of seabuckthorn resources, accounting around 90% of the global resources, including 722,000 ha of natural ones, 1,419,000 ha of artificial ones for ecological purposes and economic purposes. In China, seabuckthorn distributes naturally in 12 provinces (or autonomous regions, or municipality) e.g. Beijing, Hebei, Shanxi, Inner Mongolia, Sichuan, Yunnan, Tibet, Shaanxi, Gansu, Qinghai, Ningxia and Xinjiang. And it has been artificially planted in 5 provinces e.g. Liaoning, Jilin, Heilongjiang, Henan and Shandong.

In 2021, around 70,000 ha of seabuckthorn was planted, including 49,000 ha for ecological purpose and 21,000 ha for economic purpose.

1. 全国沙棘资源总面积及当年新增面积（含天然林和人工生态林、经济林）、当年（估算）鲜果实总产量及采收量。主要人工种植区（种植园）简要介绍

中国是天然沙棘林和人工种植沙棘面积最大的国家。截止 2021 年 12 月，全国沙棘资源总面积约 3212 万亩（约合 214.1 万公顷），约占世界沙棘资源总面积 3605 万亩（约合 240.3 万公顷）的 90%。全国人工沙棘林 2129 万亩（约合 141.9 万公顷），其中人工生态林 2004 万亩、经济林约 125 万亩，天然沙棘林 1083 万亩（约合 72.2 万公顷）。全国 17 个省、自治区、直辖市（北京、河北、山西、内蒙古、辽宁、吉林、黑龙江、山东、河南、四川、云南、西藏、陕西、甘肃、青海、宁夏、新疆）有天然分布沙棘或人工种植沙棘。

2021 年，全国新增 105 万亩人工沙棘林（7 万公顷），其中人工生态林 73 万亩（约 4.9 万公顷）、经济林 32 万亩（约 2.1 万公顷）。受产业原料价格上涨和国家生态林建设政策影响，2021 年沙棘林新增面积比 2020 年新增面积 96 万亩（6.4 万公顷）略有上升。

Since 1998, Management Center for Seabuckthorn Development, Ministry of Water Resources has planted seabuckthorn ecological forests in a large scale in Inner Mongolia, Shanxi and Shaanxi provinces, which are located on the Loss Plateau, with a total planting area of more than 510,000 ha, of which more than 3,300 ha was newly planted in 2021.

In estimation for the year of 2021, there were around 600,000 to 700,000 tonnes of yielding seabuckthorn berries, 250,000 to 300,000 tonnes of harvesting available and 200,000 to 250,000 tonnes of harvested. Because of the inconvenience caused by thorny and remote mountainous location, the practical harvesting rate of natural seabuckthorn stands was about 15% of the total yields.

In 2021, around 60,000 ha of artificial seabuckthorn plantation for economic purposes in Xinjiang, Heilongjiang, Jilin, Hebei and Inner Mongolia is coming in high yield ages and is expected to supply with 150,000-200,000 tonnes of fresh berries per year and with the growth of 10-15% annually. Main resources and distribution locations are listed as in Table 1.

1998 年以来，水利部沙棘开发管理中心在地处黄土高原的内蒙古、山西、陕西省大规模人工种植沙棘生态林，累计种植 765 多万亩（约合 510,000 公顷）。其中，2021 年新种植面积 5 万余亩（约合 3300 公顷）。

2021 年全国野生沙棘结果情况比 2020 年略有下降，果实产量较上一年减少约 1 万吨；人工沙棘林结果情况，受大果沙棘种植面积增加和盛果期面积增加，人工沙棘林产果量较 2020 年增加 15-20% 左右。据估算，2021 年全国沙棘鲜果实产量在 60 万 -70 万吨之间，可采收约 25 万 -30 万吨，实际采收加工利用约 20 万 -25 万吨。其中野生中国沙棘果实产量在 20 万 -30 万吨，实际采收在 2 万 -3 万吨，较 2020 年略有下降，减量主要原因是我国沙棘多分布在大山沟深地区，并且沙棘有刺，不便采收，造成沙棘资源浪费，而且适逢野生沙棘的产量小年。

人工沙棘生态林鲜果储量在 25 万吨左右，实际采收量达到 5 万 -6 万吨之间。2021 年，位于新疆、黑龙江、吉林、以及内蒙古、河北北部人工种植的约 90 万亩大果沙棘原料林逐渐进入结果期，每年大果沙棘果实可采收的产量 15 万 -20 万吨，并且其产量将以每年 10-15% 速度增长。表 1 为我国主要沙棘产区沙棘资源与分布情况。



Table 1. Total area up to 2021 and the newly increased area of seabuckthorn in 2021 in China (unit: 10,000 mu, 1 ha is equal to 15 mu)

表 1. 2021 年中国主要省现有及新增沙棘资源面积 (万亩, 1 公顷 =15 亩)

产区 Province	截至 2021 年底 Up to 2021	2021 年新增沙棘生态林 New SBT for ecological purpose	2021 年新增沙棘经济林 New SBT for economic purpose
河北 Hebei	125	2	2
山西 Shanxi	591	6	3
内蒙古 Inner Mongolia	605	15	5
辽宁 Liaoning	96	3	2
吉林 Jilin	22	2	2
黑龙江 Heilongjiang	57	1	2
四川 Sichuan	64	4	0
云南 Yunnan	11	0	0
西藏 Tibet	138	5	3
陕西 Shaanxi	371	8	3
甘肃 Gansu	490	6	4
青海 Qinghai	460	9	1
宁夏 Ningxia	93	2	1
新疆 Xinjiang	84	10	4
其他地区	460	9	1
Other provinces	6		
合计 in total	3212	73	32
其他地区			
Other provinces	6		
合计 in total	3212	73	32

2. Introduction of genetic resources including natural seabuckthorn species and subspecies of Hippophae and names of newly bred seabuckthorn varieties and introduced cultivars from other countries and their performance including morphological/biochemical features.

Seabuckthorn is found in 52 countries in the world. China has the most abundant natural seabuckthorn germplasm resources in the world. According to the classification by Professor LIAN Yongshan, Chinese

2. 沙棘种质资源情况, 天然分布的种类 (种、亚种), 培育的新品种名称、从国外引种的沙棘品种名称及其形态学、生化学性状。

全球约 52 个国家有沙棘分布。中国是世界上天然沙棘种质资源最丰富的国家。按照我国沙棘植物学家廉永善的分类法, 沙棘属植物分为

taxonomic scientist, there are globally 6 species and 12 subspecies of seabuckthorn. Among them, located in China 6 species and 8 subspecies e.g. *Hippophae rhamnoides ssp. sinensis*, *Hippophae rhamnoides ssp. yunnanensis*, *Hippophae rhamnoides ssp. turkestanica*, *Hippophae rhamnoides ssp. mongonica*, *Hippophae salicifolia*, *Hippophae tibetana*, *Hippophae gyantsensis*, *Hippophae neurocarpa ssp. stellatopilosa*, *Hippophae neurocarpa ssp. neurocarpa*, *Hippophae goniocarpa*, *Hippophae goniocarpa ssp. litangensis*, *Hippophae goniocarpa ssp. goniocarpa*.

China has introduced from Russia, Mongolia, Germany, Finland a dozen of improved seabuckthorn varieties with good economic properties of large berry, reliable yield, high content of seed oil, less thorn or thornless, convenience for harvesting and processing. At the same time, organized by Management Center for Seabuckthorn Development, Ministry of Water Resources, the national network is undertaking seabuckthorn selection, introduction and cross breeding. In the coming one or two years, 6-10 new seabuckthorn varieties with superb properties and good adaptability in Northern China will come to being.

3. In the year of 2021, the number of seabuckthorn enterprises, the gross output and the total value of seabuckthorn products in the country and a brief introduction of main enterprises and their main products of seabuckthorn.

Chinese seabuckthorn industry started in 1980's and in rapid development in early 21st century. Following the national R&D, China is leading in the utilization and production of seabuckthorn juice, leaf, lipid, pharmaceutical application of flavonoids etc. At the present, around 200,000 to 250,000 tonnes of fresh seabuckthorn berries be harvested and consumed annually.

China is currently the country with the most seabuckthorn products developed and applied,

6个种 12个亚种, 其中在中国分布有6个种 8个亚种, 分别是鼠李沙棘(种)、柳叶沙棘(种)、西藏沙棘(种)、江孜沙棘(种)、肋果沙棘(种)、棱果沙棘(种), 中国沙棘(亚种)、云南沙棘(亚种)、中亚沙棘(亚种)、蒙古沙棘(亚种)、密毛肋果沙棘(亚种)、肋果沙棘(亚种)、理塘沙棘(亚种), 棱果沙棘(亚种)。

目前我国先后从蒙古、俄罗斯、德国、芬兰等国引进了优良沙棘品种, 其特点是果实大、种子含油量高、枝条无刺、易采摘和加工。同时, 水利部沙棘开发管理中心牵头组织的全国沙棘育种网, 正在采用“选、引、育”相结合的科学方法, 有望在近1-2年培育出6-10个具有果实大、产量高、无刺或少刺、抗性强、营养成分丰富、适宜在“三北”地区广泛应用等综合优势的沙棘新品种。

3. 目前全国沙棘企业总数、总产量、总产值。 主要生产企业及产品简要介绍

我国的沙棘产业起步于20世纪80年代中后期, 在21世纪初开始快速发展。近年来沙棘高科技产品不断出现, 在沙棘果汁、叶、油脂、黄酮药用等研究开发利用领域已处于国际先进水平。全国目前每年生产加工利用约20万-25万吨沙棘鲜果实。

中国是目前开发应用沙棘产品最多的国家, 其产品涵盖了食品、药品、保健品、化妆品等8

covering more than 200 varieties in 8 categories such as food, medicine, health care products and cosmetics. After more than 30 years of development, there are more than 3,200 sea-buckthorn enterprises in China, among which more than 200 are processing enterprises with sea-buckthorn as the main product, with an annual production value of about 26 billion yuan. Gaoyuan Shengguo Sea-buckthorn products Co., LTD., Beijing Powder Health Industry Co., LTD., Shaanxi Haitian Pharmaceutical Co., LTD., Shanxi Luliang Yeshanpo Food Co., LTD., Hebei Shenxing Sea-buckthorn Research Institute are among the outstanding ones, and have achieved good economic and social benefits.

In terms of food processing, sea-buckthorn can be used as raw material to make a variety of beverage and wine, such as fruit juice drinks, fruit wine, jam, cakes and dairy products, etc. In the field of medicine and health care, there are preparations for treating cardiovascular and cerebrovascular diseases, eliminating phlegm, benefiting lung, nourishing stomach, strengthening spleen, promoting blood circulation and removing blood stasis, burning and scalding, knife injury and frostbite, etc. Sea-buckthorn also shows its unique value in light industry and other aspects. Developed skin care products and cleanses that nourish skin, promote cell metabolism, promote epithelial tissue regeneration, have anti-allergy, antibacterial, strong penetrability and protect skin's natural color. Seabuckthorn stems have hard wood and can be used as raw materials for building materials such as plywood.

In recent years, sea-buckthorn seed oil, fruit oil, fruit powder, procyanidin, flavonoids, dietary fiber and so on are the main extracts of sea-buckthorn in the domestic and foreign markets. Seabuckthorn seed oil and fruit oil, as intermediates and raw materials of drugs, cosmetics and functional foods, have broad application fields and huge market potential. The demand for various natural sea-buckthorn extracts and fruit juices, such as seabuckthorn concentrate juice, fruit powder, oil, flavonoids, etc.,

大类 200 多个品种。经过 30 多年的发展，全国现有各类沙棘企业 3200 余家，年加工各类沙棘制品 30 多万吨。其中，以沙棘为主要产品的加工企业 200 多家，年产值约 70 亿元，加上其他沙棘企业的销售收入，全沙棘行业产值达 240 亿 -260 亿元。其中高原圣果沙棘制品有限公司、北京宝得瑞健康产业有限公司、山西吕梁野山坡食品有限公司、河北神兴沙棘研究院、陕西海天制药有限公司、清华德人西安幸福制药有限公司、内蒙古宇航人高技术产业有限公司、内蒙古沙漠之花生态产业有限公司等都是其中的佼佼者，取得了较好的经济社会效益。

在食品加工方面，以沙棘为原料可制成多种饮料食品 and 酒类，如：果汁饮品、果酒、果酱、各种糕点及奶制品等；在医药保健方面，有用于治疗心脑血管系统病症、祛痰、利肺、养胃、健脾、活血化瘀、烧烫伤、刀伤及冻伤等方面的制剂；在轻工及其它方面，沙棘也显示了其独特的价值；开发了滋养皮肤、促进细胞代谢、促进上皮组织再生、具有抗过敏、抑菌、强渗透力和保护皮肤自然色泽的护肤用品及洗化用品；沙棘的枝干木质坚硬，可用于制作胶合板等建筑材料的原料。

近年来，国内外市场上的沙棘提取物主要为沙棘籽油、沙棘果油、沙棘果粉、原花青素、沙棘黄酮、沙棘膳食纤维等。沙棘籽油和果油作为药品、化妆品、功能食品的中间体和原辅料，应用领域广阔、市场潜力巨大。对各种天然沙棘提取物和果汁，如沙棘汁浓缩汁、沙棘果粉、

has doubled. Some well-known enterprises at home and abroad, such as Nestle, Procter & Gamble, have launched or developed a number of seabuckthorn related products. According to statistics, there are more than 200 kinds of seabuckthorn related products such as functional food, beverage, medicine, beauty and skin care products, washing articles, feed, bait and so on. (As shown in Table 2)

沙棘油、沙棘黄酮等的需求成倍增长，一些国内外知名企业如美国雀巢公司、美国宝洁公司等都已推出或开发了多个沙棘相关产品。据统计，目前市场上已形成销售的沙棘类相关产品有功能食品、饮料、药品、美容护肤产品、洗涤用品、饲料、饵料等八大类约 200 多种产品。（见附表 2）

Table 2. The applicaton of seabuckthorn in China
表 2. 沙棘应用情况

应用领域 Application sections	应用范围 Function subjects	相关产品 Products
食品加工 Food production	饮料、果酒、果醋、果酱、糕点、奶制品 drink, wine, vinegar, jam, pastry, dairy products, etc.	沙棘醋、沙棘酒、沙棘茶 seabuckthorn vinegar, wine, tea
医药保健 Medicine & healthcare product processing	心脑血管、祛斑、润肺、健脾养胃、宫颈糜烂、外伤 treatment for cardiovascular, gastric ulcer, lung improvement, cervical erosion, scald, burn, etc.	五味沙棘散、参芪沙棘合剂 Wuwei seabuckthorn power, seabuckthorn compounds with ginseng and jaundicen
轻工业及其他方面 Daily stuffs processing	化妆品、洗涤用品 cosmetic, detergent etc,	沙棘护肤产品 seabuckthorn products for skin protection

According to incomplete statistics, from 2019 to 2021, the sales revenue of sea-buckthorn extract products alone in China was 2.1 billion yuan, 2.5 billion yuan and 3.1 billion yuan respectively. It is estimated that the output value of downstream industries such as drugs, cosmetics and health products corresponding to sea-buckthorn plant extract products is about 1:22.

据不完全统计，2019 年至 2021 年，仅沙棘提取物产品的销售收入分别为 21 亿元、25 亿元、31 亿元。数据显示，沙棘产业每年都有明显的增长，预计到 2022 年销售收入达到 38 亿元左右。据测算，沙棘植物提取物产品对应的药品、化妆品、保健品等下游产业的产值为 1:22 左右。



Sea-buckthorn enterprises in China have developed more than 200 products in eight categories, including food, beverage, medicine and health care, daily chemicals, feed and bait, with an annual output value of more than 26 billion yuan. Sea-buckthorn products not only promote the rational use of resources, mobilize the enthusiasm of the masses to plant sea-buckthorn, but also create a new way for people in poor mountainous areas to get rid of poverty and get rich. In sea-buckthorn planting areas, farmers rely on fruit and leaves harvest and development to raise sheep and cattle, with an average income of 200 yuan.

Seabuckthorn extract products, seabuckthorn seed oil, fruit oil, flavonoids and procyanidins are currently the most exuberant products in the market, the market is in high demand. Seabuckthorn fruit powder, as a new functional product additive or raw material, is now being recognized and accepted by relevant industries and markets in China. In recent years, the market demand has grown particularly rapidly.

4. The status of seabuckthorn scientific institution in the country in terms of the number of institutes and their scientists and their research field, and a brief introduction of main research institutes/universities and enterprises, the main research programs and updated achievements on seabuckthorn.

4.1. Management Center for Seabuckthorn Development (MCSD), Ministry of Water Resource

MCSD was established in 1985 with the coordinating function for national seabuckthorn resources management and utilization, R&D, international cooperation. There are four enterprises and two

全国沙棘企业已经开发出了食品、饮料、医药保健、日化、饲料、饵料等八大类约 200 多种产品，年产值 260 亿元以上。沙棘产品不仅促进了资源的合理利用，调动了群众种植沙棘的积极性，而且为贫困山区人民脱贫致富创出了一条新路，在沙棘种植区农民靠采果和叶及发展养羊、养牛，人均增收达 200 元。

沙棘提取物产品中，沙棘籽油、果油、黄酮和原花青素是目前市场需求最为旺盛的产品，市场处于供不应求的状态。沙棘果粉作为新兴功能产品添加剂或原辅料，目前正在被中国相关行业和市场所认识并接受，近年来，市场需求增长尤为迅速。

4. 全国沙棘科学研究情况（大学、研究所、企业），重点研究单位（研究人员、研究领域、主要成果）简要介绍

4.1. 水利部沙棘开发管理中心

水利部沙棘开发管理中心（以下简称沙棘中心）前身是成立于 1985 年的全国水资源与水土保持工作领导小组沙棘协调办公室（简称全国沙棘办公室），1997 年更名为水利部沙棘开发管理中心，承担着全国沙棘资源建设、开发利用、科学研究、国际合作等方面的协调管理工作。沙棘中心下辖 4 家沙棘加工示范企业，并在内蒙古自治区鄂尔多斯市准格尔旗、达拉特旗建有 2 处沙棘育种或苗木繁育基地。目前，沙棘中心有专门从事沙棘研究和管理的专职人员 9

nurseries affiliated to MCSD. Currently, there are 20 full time staffs.

Since 1985, hosted by MCSD, 13 national standards on seabuckthorn have been issued, 8 national patents certified, 9 scientific achievement prizes received, 28 new superb varieties or cultivars selected.

4.2 Berry Research Institute of Heilongjiang Academy of Agricultural Science

Located in Harbin, capital of Heilongjiang province, the institute has been involving in seabuckthorn genetic resources collection and evaluation, variety breeding, selection, and extension etc, since 1988. Hosted by the institute, 2 provincial standards on seabuckthorn have been issued, 1 national patents certified, 15 scientific achievement prizes received, 6 new superb varieties or cultivars selected. Currently, there are 4 staffs involving in seabuckthorn research with 10 ha of land and one green house for experiment and nursery producing yearly more 200,000 seabuckthorn seedlings.



人，其中正高级 6 人，副高级 3 人。

1985 年以来，沙棘中心负责编制有关沙棘方面的标准 13 个，其中水利部行业标准 8 个，国际沙棘协会团体标准 5 个。获得国家专利 8 项，获得各类科技进步奖 9 项，其中：省部级 4 项，其他 5 项。主编出版专著 8 部、文集 4 部；发表科技论文约 150 篇。现有各类沙棘良种 28 个，其中杂交沙棘品种 6 个，引进沙棘良种 10 个，选育沙棘品种 12 个。

4.2. 黑龙江省农业科学院乡村振兴科技研究所

黑龙江省农业科学院乡村振兴科技研究所（简称乡村振兴所）位于黑龙江省哈尔滨市。乡村振兴所成立于 1948 年，原名为黑龙江省农业科学院浆果研究所，面向东北黑土区从事浆果资源搜集、育种及相关栽培技术研究，有沙棘研究用地 100 余亩，沙棘育苗大棚 1 栋，植物组培实验室 1 个，以及多种科研试验设施和仪器。

1988 年起，乡村振兴所开始国内外沙棘种质资源的搜集整理评价、新品种选育、试验示范及推广等研究工作。截止目前，乡村振兴所已获有关沙棘方面的各类科技奖 15 项，其中：省部级 7 项，其他 8 项。编写或参编出版专著 7 部；发表科技论文 40 余篇。制定省级标准 2 项。获得发明、实用新型专利各 1 项。选育沙棘良种 6 个，品系 100 余个。在哈尔滨基地后，乡村振兴所新建沙棘各类试验场圃 70 亩、苗圃地 10 亩，年产沙棘苗木 20 万株。目前，有 4 人参与沙棘相关的各项工作，其中：正高级 1 人，中级 1 人，其他 2 人。

4.3 Liaoning Institute for Dry Land Agro-forestry Research

Located in Chaoyang City, Liaoning province, the institute has been conducting in seabuckthorn variety introduction, propagation and cultivation experiment.

Since 1959, 2 provincial standards on seabuckthorn have been issued, 2 national patents certified, 10 scientific achievement prizes received, 3 new superb varieties or cultivars selected. Currently, there are 8 staffs involving in seabuckthorn research with 4 ha of land and 2 gene pools for experiment and nursery producing yearly more 100,000 seabuckthorn seedlings.

4.4 Xifeng Experimental Station for Soil and Water Conservation, Yellow River Conservancy Commission



4.3. 辽宁省旱地农林研究所

辽宁省旱地农林研究所（以下简称旱地所）位于辽宁省朝阳市，隶属于辽宁省农业科学院，由原辽宁省水土保持研究所和原辽宁省干旱地区造林研究所于 2018 年 11 月优化整合而成。主要工作职责是开展水土保持、森林培育、退化生态系统恢复技术，及杂粮、果蔬、林木新品种选育、栽培和加工技术研究等，设有辽宁省土壤侵蚀与水土保持重点实验室，拥有土壤、植物研究需要的科研仪器设备。全所建有 4 处科研生产基地，建有沙棘种质资源圃、生产示范园、采穗圃及育苗圃，总面积近 60 亩。

从 1959 年开始，旱地所即开始沙棘引种栽培试验，截止目前，已获有关沙棘方面的各类成果奖 10 项，其中：省部级 7 项，市厅级 3 项。参编专著 2 部，发表科技论文 60 余篇。获得实用新型专利 2 项；制定辽宁省地方标准 2 项。现拥有沙棘良种 3 个、品系 40 多个。建立有多功能沙棘育种圃 2 处。有沙棘苗圃地 5 亩，每年可提供引进大果、蒙中杂交等优质沙棘苗木 10 万株。目前，有 8 人参与沙棘工作，其中：正高级 2 人，副高级 2 人，中级 3 人，其他 1 人。

4.4. 水利部黄河水利委员会西峰水土保持科学试验站

黄河水利委员会西峰水土保持科学试验站（以下简称西峰水保站）位于甘肃省庆阳市，成立于 1951 年，为水利部系统建站悠久的水保“三站”之一，面向黄土高原沟壑区从事水土保持试验研究、综合治理和示范推广等业务。从 1957 年开始，有关沙棘的试验研究涵盖了育苗、

Located in Qingyang city, the Station was established in 1951 for research, comprehensive management and technological extension on soil conservation in the Loss Plateau. Since 1957, seabuckthorn seedling propagation, breeding and cultivation demonstration has been conducting with 8 scientific achievement prizes, 4 professional publication and 50 plus scientific papers. Currently, there are 8 staffs involving in seabuckthorn research with 4 ha of land for breeding and propagation producing yearly more 100,000 seabuckthorn seedlings.

4.5 Tianshui Experimental Station for Soil and Water Conservation, Yellow River Conservancy Commission

Located in Tianshui city, the Station was established in 1942 for research, comprehensive management and technological extension on soil conservation in the Loss Plateau. Since 1950's, seabuckthorn research and utilization for soil conservation has been implementing with 6 scientific achievement prizes and 20 plus scientific papers. Currently, there are 12 staffs involving in seabuckthorn research with 0.4 ha of nursery producing yearly more 100,000 seabuckthorn seedlings.

4.6 Qinghai-Tibet Plateau Natural Botanical Research Institute, Qinghai Academy for Agroforestry Sciences

Located Xining city, capital of Qinghai province, the Station was established in 1951. Since 1950's,

育种、种植示范等多方面工作。截止目前,已获有关沙棘方面的各类科技进步奖 8 项,其中:国家级 1 项,省部级 3 项,其他 4 项。编写或参编出版专著 4 部;发表科技论文 50 余篇。建立多功能沙棘育种圃 2 处 49 亩,苗圃 5 亩,年产苗木 10 万株。目前,全站有 8 人参与沙棘有关各项工作,其中:正高级 1 人,副高级 2 人,中级 3 人,其他 2 人。

4.5. 水利部黄河水利委员会天水水土保持科学试验站

黄河水利委员会天水水土保持科学试验站(以下简称天水水保站)位于甘肃省天水市,成立于 1942 年,为水利部系统建站最为悠久的水保站,面向黄土丘陵沟壑区从事水土保持试验研究、综合治理、示范推广等工作。建站后不久即开始了沙棘有关试验研究。截止目前,已获有关沙棘方面的各类科技进步奖 6 项,其中:国家级 1 项,省部级 2 项,其他 3 项。发表科技论文 20 余篇。有沙棘专用苗圃地 5 亩,年产苗木 10 万株。目前,全站有 12 人参与沙棘有关的各项工作,其中:正高级 1 人,副高级 1 人,中级 2 人,其他 8 人。

4.6. 青海省农林科学院青藏高原野生植物资源研究所

青海省农林科学院青藏高原野生植物资源研究所(以下简称野生所)位于青海省西宁市,沙棘育种基地位于青海省大通县城关镇。青海省农林科学院成立于 1951 年,下设 8 个专业研

information research, natural resources, ecology, seedling propagation on seabuckthorn has been conducting with 9 provincial standards, 4 scientific achievement prizes, 3 professional publication and 60 plus scientific papers. Currently, there are 7 staffs involving in seabuckthorn research with 4 ha of nursery producing yearly more 100,000 seabuckthorn seedlings.

4.7. Desert Forestry Experimental Center (DFEC), Chinese Academy of Forestry Science

Located in Dengkou county of Inner Mongolia, DFEC was established in 1979 for botanical genetic resources collection, afforestation technology improvement for shelter belt construction in Hetao desert regions. Since 1986, seabuckthorn variety improvement and seedling propagation has been conducting with 3 scientific achievement prizes, 3 professional publication and 20 plus scientific papers. Currently, there are 10 staffs involving in seabuckthorn research with two modernized labs and 15 ha of land for breeding and nursery producing yearly more 100,000 seabuckthorn seedlings.



究所，全院设有综合分析实验室和生物技术实验室，综合分析室。从上世纪 50 年代开始，即开始沙棘情报、群落、育苗、种植及生态等多方面工作。截止目前，野生所已获有关沙棘方面的省部级科技进步奖 4 项，参编出版专著 3 部，发表科技论文 60 余篇。制定青海省地方标准 9 项，获得专利 1 项、省级良种 1 个。有沙棘专用育苗地 5 亩，年可产优质沙棘苗木 10 万株。目前从事沙棘研究的人员有 7 人，其中正高级 2 人、副高级 2 人、中级 3 人。

4.7. 中国林业科学研究院沙漠林业实验中心

中国林业科学研究院沙漠林业实验中心（以下简称沙林中心）坐落在内蒙古自治区磴口县，成立于 1979 年，面向黄河河套区主要从事树种资源收集与改良造林技术、人工绿洲防护林营造技术及生态经济效益试验研究，从 1986 年开始沙棘良种选育试验研究。沙林中心有实验室 2 个，可用于常规植物生理学实验分析和土壤理化实验分析；在第一实验场建有植物组培楼 1 座，面积 427m²，现代化温室 1 座，面积 1200m²；建有沙棘育苗棚 1 座，面积 480m²。

沙林中心获有关沙棘方面的各类科技进步奖 3 项，其中：国家级 1 项，省部级 2 项。参编出版专著 3 部；发表科技论文 20 余篇。建立多功能沙棘育种圃 2 处、200 亩，参与完成 9 个沙棘品种的试验研究工作。有专用沙棘苗圃地 5 亩，每年可提供各类优质沙棘苗木 10 万余株。目前，沙林中心有 10 人参与沙棘有关工作，其中：副高级 2 人，中级 3 人，其他 5 人。

In 2021, as a member of National Network for Seabuckthorn Breeding and the focal point of national seabuckthorn gene pools, DFEC's main achievements included the establishment of 5 mu of experimental fields, seedlings propagation for 10 kinds of SBT cross breeding combination, wood cutting seedlings propagation for 7 SBT varieties. DFEC also conducted 5 combination of cross breeding. Three new SBT varieties, namely Hongji 1, Zhongji 3 and Zhongji 4 were certified by the state forestry authority.

沙棘中心作为水利部沙棘中心育种协作网成员单位、沙棘国家林木种质资源库建设的实施单位，2021年依托水利部重点项目和沙棘种质资源库项目，主要围绕建立无性系试验田圃、实生选优育苗、沙棘无性系苗木生产和杂交选育试验等方面开展工作。

(1) 建立无性系试验田圃5亩，并于2021年3月完成整地工作，于4月严格按照协作项目



工作安排，对来自协作网络成员单位的 14 个编号、420 株优良品系进行苗木定植，定植规格均为 1.5m×2m，定植后及时进行浇水等抚育管理。

(2) 实生选优育苗。对来自育种协作网成员单位的 10 个组合、4700 多粒杂交种子进行催芽、穴播。

(3) 无性系苗木生。6 月底开始无性系苗木生产，对蒙中杂交优良单株进行嫩枝扦插育苗，包括乌兰沙林、向阳、深秋红、无刺雄、红棘 1 号、中棘 3 号、中棘 4 号等 7 个优良品种，53 个优良单株，约 18000 株。

(4) 杂交选育试验。完成沙棘控制授粉实验，共完成 5 个杂交组合，包括乌兰沙林 × 无刺雄、乌兰沙林 × 丰宁雄、丰宁雌 × 阿列伊、深秋红 × 无刺雄、向阳 × 丰宁雄。

(5) 无性系试验观测。对定植的 14 个系号沙棘无性系苗木进行株高、地径、冠幅和成活率、保存率观测。

(6) 新品种鉴定。2021 年，与中国林业科学研究院林业研究所合作，通过审核国家级良种 3 个。包括红棘 1 号（国 S-SV-HR-020-2021）、中棘 3 号（国 S-SV-HR-21-2021）和中棘 4 号（国 S-SV-HR-022-2021）。



4.8 Shanxi Academy of Forestry and Grassland Sciences (Seabuckthorn Engineering Technology Research Center of National Forestry and Grassland Administration)

Located in Taiyuan city, capital of Shanxi province, the Academy was established in 1959 focused in plant variety research, afforestation technology, forest resource protection and management. Since 1986, seabuckthorn research of genetic resources, variety improvement, seedling propagation and cultivation, products R&D has been conducting with 2 scientific achievement prizes, 4 national patents, 2 provincial standards and 60 plus scientific papers. Currently, there are 16 staffs involving in seabuckthorn research with 8 ha of land for breeding and propagation producing yearly more 100,000 seabuckthorn seedlings.

In 2021, Seabuckthorn Engineering Center has undertaken a total of 7 national and provincial scientific research projects. Around the projects and subjects, we carried out scientific research, technical services, academic exchanges, achievements transformation and promotion of seabuckthorn.

A. In terms of seabuckthorn scientific research, we carried out researches on introduction, hybrid breeding, selection of improved varieties, high-yield cultivation techniques, extraction methods of seabuckthorn active substances, and seabuckthorn pomace pretreatment equipment. In the selection and breeding of improved varieties, 14 varieties of seabuckthorn clone seedlings were introduced from Qingyang (Gansu Province), Chaoyang (Liaoning Province) and other places. The seeds of 10 introduced Hippophae rhamnoides hybrids and 119 Chinese Hippophae rhamnoides families were sown and bred. At the same time, experiments on shaping and pruning, different fertilization amounts have been carried out on the artificial seabuckthorn demonstration garden, aiming to explore and

4.8. 山西省林业和草原科学研究院（国家林业草原局沙棘工程技术研究中心）

山西省林业和草原科学研究院（以下简称“山西省林科院”）位于山西省太原市，沙棘育种试验主要基地位于山西省寿阳县。山西省林科院成立于 1959 年，面向山西省主要从事经济林、林木良种培育、林业生态与景观工程、森林经营与服务功能、资源保护及利用等方面试验研究。从 1986 年开始，有关沙棘的试验研究涵盖了种源试验、良种选育、无性繁殖、丰产栽培以及黄酮和原花青素提取、油脂超临界 CO₂ 萃取、沙棘果渣干燥及产品研发等多方面工作。截止目前，已获有关沙棘方面的省部级科技进步奖 2 项，发表科技论文 60 余篇，获得专利 4 项，制定山西省地方标准 2 项。建立沙棘种质资源圃 4 处、106 亩；有专用沙棘苗圃 5 亩，年可产优质沙棘苗木 10 万余株。目前，山西省林科院有 16 人参与沙棘有关各项工作，其中：正高级 7 人，副高级 5 人，中级 4 人。

2021 年，沙棘工程中心共承担了国家和省级科研项目 7 项，围绕课题研究任务，开展了沙棘科学研究、技术服务、学术交流和成果转化推广等方面的工作。

（1）在沙棘科学研究方面。分别开展了引种、杂交育种、良种选育、丰产栽培技术及沙棘活性物提取方法、沙棘果渣预处理设备等研究。在良种选育研究方面，从甘肃庆阳、辽宁朝阳

summarize the efficient cultivation and management techniques of the artificial seabuckthorn. In the analysis of active components of seabuckthorn, the contents of oil, flavonoids and proanthocyanidins in the whole fruit residue of seabuckthorn were determined; the content of total flavonoids in seabuckthorn fruit and leaves picked from different sites and different periods in Shanxi Province was determined; the drying technology of seabuckthorn pomace was verified, and the extraction technology and antioxidant activity of flavonoids from pomace were optimized.

B. In terms of innovation achievements, 2 local varieties have been approved, namely: Jinji No. 2 (Jin S-SC-HR-035-2021) and Yanji No. 2 (Jin S-SC-HR-036-2021). The two scientific research achievements, namely "Efficient Utilization of Seabuckthorn Processing Residues Pre-treatment and Active Extraction Technology and Equipment" and "Development of Fresh Fruit Pomace Automatic Dryer and Drying Process Optimization", have been identified to reach the international advanced level. The self-developed equipment "Fresh Pomace Automatic Dryer" has been recognized. 7 scientific papers have been published in 2021.

C. In terms of technical services, combined with the economic forest quality and efficiency improvement projects implemented by our province, seabuckthorn sowing and cutting seedlings, natural seabuckthorn forest transformation, pest control and other technologies were carried out for members of afforestation professional cooperatives in Youyu, Wenshui and other counties. The training was conducted 3 times, with a total of 300 people trained.

D. In terms of academic exchanges, in July 2021, we participated in the mid-term exchange and observation meeting of seabuckthorn breeding in 2021 organized by Management Center for Seabuckthorn Development, Ministry of Water Resources in Dengkou County, Inner Mongolia. In November 2021, we participated in the video

等地引进沙棘无性系苗木 14 个系号；对引进的 10 个沙棘杂交选育种子和 119 个中国沙棘优良家系种子进行播种育苗；对人工沙棘示范园进行整形修剪、不同施肥量等试验，旨在探索总结人工沙棘示范园的高效栽培管理技术。在沙棘活性成分分析方面，测定了沙棘全果渣中油脂、黄酮、原花青素的含量；对山西省不同立地、不同时期采摘的沙棘果、沙棘叶进行了总黄酮含量的测定；开展了沙棘果渣干燥工艺性能验证，并对果渣中黄酮进行提取工艺优化及抗氧化活性研究。

(2) 在创新成果方面。审定地方良种 2 项，分别为：晋棘 2 号（晋 S-SC-HR-035-2021）和雁棘 2 号（晋 S-SC-HR-036-2021）。鉴定成果 2 项，分别为：《沙棘加工剩余物高效利用预处理及活性物提取技术与设备》、《鲜果渣自动干燥机的研制及干燥工艺优化》，均达到国际先进水平。认定设备《鲜果渣自动干燥机》1 台。发表论文 7 篇。

(3) 在技术服务方面。结合山西省实施的经済林提质增效工程，分别在山西右玉、文水等县，对造林专业合作社社员开展了沙棘播种及扦插育苗、天然沙棘林改造、病虫害防治等技术培训 3 次，累计培训人数 300 人次。

(4) 在学术交流方面。2021 年 7 月，在内蒙古磴口县参加了水利部沙棘管理中心组织的 2021 年沙棘育种工作中期交流观摩会。2021

conference of the Academic Exchange Conference on Plants for Efficient Soil and Water Conservation organized by Ministry of Water Resources. In December 2021, Engineering Center held the 2021 annual work meeting and academic exchange meeting.

E. In terms of achievement transformation, the Seabuckthorn Engineering Technology Research Center successfully applied for the 2021 Central Finance Forestry Science and Technology Promotion Demonstration Project “Technical Demonstration of Seabuckthorn Seedling Breeding and Afforestation” based on the national standard “Technical Regulations for Afforestation” and the local standard “Technical Regulations for Seabuckthorn Cuttings Raising Seedlings”. The implementation of this project has further strengthened the scientific and technological support for the development of the seabuckthorn industry.

5. The total personnel involved in seabuckthorn research, manufacturing, marketing planting, public management, etc. in the country, and the members of National Seabuckthorn Association.

In the past 30 plus years, China has established a powerful seabuckthorn expert team, with around 15,000 professionals, covering forestry, agriculture, water and soil conservation, gardening, medicine, food industry, etc. China is the ISA Chairman country and ISA Secretariat is affiliated with Management Center for Seabuckthorn Development (MCSD) of Ministry of Water Resources. In recent years, we have included many qualified experts who are both professional and proficient in English communication, and served as chairman or the co-chairman in the academic exchange session at the International Seabuckthorn Association Conference, showing the active role of global seabuckthorn activities.

The Enterprise Committee (China) as a sub-organization of International Seabuckthorn

年 11 月，参加了水利部举办的高效水土保持植物学术交流会的视频会议。2021 年 12 月，工程中心举办了 2021 年度工作年会暨学术交流会。

(5) 在成果转化方面。沙棘工程中心依托国标《造林技术规程》和地方标准《沙棘扦插育苗技术规程》成功申报了 2021 年中央财政林业科技推广示范项目《沙棘良种苗木繁育及造林技术示范》，进一步加大了对沙棘产业发展的科技支撑。

5. 全国沙棘从业人员情况，全国性协会会员总数（团体会员）。国际沙棘协会主要会员单位介绍

30 多年来，我国建立了强大的沙棘专家团队，从业人员约 15000 多人，包括林业、农业、水土保持、园艺、卫生等十多个行业和领域。我国是国际沙棘协会主席国，水利部沙棘开发管理中心是国际沙棘协会秘书长单位。近年来，培养了一些既懂专业又熟练掌握英语交流能力的知名专家，多次担任国际大会学术交流环节的联合主席，展示出我国的沙棘大国风范。

国际沙棘协会（中国）企业委员会成立于 2017 年 5 月，是国际沙棘协会的二级机构，

Association, was established in May 2017, with 91 corporation/institute members and 450 plus individual members by the end of 2021. (See the detail in Table 3)

截止 2021 年底，有团体会员 96 个、个人会员 450 多人。（详见附表 3）

Namelist of Enterprise Committee (China)/ISA Members
表 3. 国际沙棘协会（中国）企业委员会团体会员名单

序号	名称 Name of member	备注 Title in Committee	联系人 Contact person	职务 Title
1	高原圣果沙棘制品有限公司 Gaoyuanshengguo Seabuckthorn Co. Ltd	会长单位 Chairman	卢健 LU Jian	总经理 General Manager
2	北京宝得瑞健康产业有限公司 Beijing Powder Health Industrial Co. Ltd	副会长单位 Vice Chairman	王辉斌 WANG Huibin	总经理 General Manager
3	河北神兴沙棘研究院 Hebei Shenxing Seabuckthorn Academy	副会长单位 Vice Chairman	张泽凯 ZHANG Zekai	营销总监 Marketing Manager
4	山西吕梁野山坡食品有限责任公司 Lvliang Yeshanpo Food Co.Ltd	副会长单位 Vice Chairman	牛茂林 NIU Maolin	董事长 Chairman
5	内蒙古吉隆生态科技有限责任公司 Inner Mongolia Jilong Eco-tech Co. Ltd	副会长单位 Vice Chairman	刘三利 LIU Sanli	董事长 Chairman
6	上海容邦企业集团有限公司 Shanghai Rongbang Enterprise Group Co., Ltd.	副会长单位 Vice Chairman	李相军 LI Xiangjun	董事长 Chairman
7	陕西海天制药有限公司 Shaanxi Haitian Pharmaceutical Co.Ltd	副会长单位 Vice Chairman	宋凯乐 Song kaile	董事长助理 Assistan to Chairman
8	青海康普生物科技股份有限公司 Qinghai CommScope Bio-technology Co., Ltd.	副会长单位 Vice Chairman	孙允武 Sun Yunwu	总经理 General Manager
9	新疆康元生物科技股份有限公司 Xinjiang Kangyuan Bio-tech Co. Ltd	副会长单位 Vice Chairman	刘宗浩 LIU Zonghao	董事长 Chairman
10	山西五台山沙棘制品有限公司 Shanxi Wutaishan Seabuckthorn Co. Ltd	理事单位 Board member	赵志侃 ZHAO Zhikan	董事长 Chairman
11	山西省林业和草原科学研究院 Shanxi Academy of Forestry and Grassland Sciences	理事单位 Board Member	贺义才 He Yicai	所长 Director
12	鸿泰农林科技开发有限公司 Hongtai Agri-Forestry Technical Development Co. Ltd	理事单位 Board member	张艳锋 ZHANG Yanfeng	董事长 Chairman

13	山西科林生物技术开发有限公司企业 Shanxi Kelin Bio-tech Development Co. Ltd	理事单位 Board member	宁聚保 NING Jubao	总经理 General Manager
14	山西助农药茶资源开发有限公司 Shanxi Zhunong Hherbal Tea Resources Development Co. Ltd	理事单位 Board member	宫铁军 GONG Tiejun	董事长 Chairman
15	内蒙古淳点实业有限公司 Inner Mongolia Chundian Industry Co. Ltd	理事单位 Board member	毕书杰 BI Shujie	董事长 Chairman
16	内蒙古森工集团有限公司 Inner Mongolia Wood Industry Co. Ltd	理事单位 Board member	许玉成 XU Yucheng	处长 Division Chief
17	内蒙古大兴安岭重点国有林管理局 Inner Mongolia Daxinganling State-owned Forestry Bureau	理事单位 Board member	周艳昌 ZHOU Yanchang	总会计师 Chief Accountant
18	内蒙古沙漠之花生态产业科技有限公司 Inner Mongolia Shamoizhuhua Bio-industry Tech Co. Ltd	理事单位 Board member	胥申 XU Shen	董事长 Chairman
19	内蒙古宇航人高技术产业有限责任公司 Inner Mongolia Yuhangren High-tech Industry Co. Ltd	理事单位 Board member	姚玉军 YAO Yujun	业务经理 Manager
20	内蒙古鄂尔多斯乌兰集团公司 Inner Mongolia Erdos Wulan Group Co.	理事单位 Board member	康占义 KANG Zhanyi	副总经理 Deputy General Manager
21	大连民族大学植物研究所 Botanical Institute of Dalian Minzu University	理事单位 Board member	阮成江 Ruan Chengjiang	所长 Director
22	辽宁省旱地农林研究所 Liaoning Provincial Institute for Dryland Agro-forestry Research	理事单位 Board member	张东为 Zhang Dongwei	副所长 Deputy Director
23	因科瑞斯药业（营口）有限公司 Incess Pharmaceuticals (Yingkou) Co., Ltd.	理事单位 Board member	胡小虎 Hu Xiaohu	部门经理 Department manager
24	黑龙江圣宝泰农业有限公司 Heilongjiang Shengbaotai Agriculture Co. Ltd	理事单位 Board member	赵胜臣 ZHAO Shengchen	董事长 Chairman
25	黑龙江省八面通林业局 Bamiantong Forestry Bureau of Helongngjian Province	理事单位 Board member	段国庆 DUAN Guoqing	副局长 Deputy Head
26	黑龙江延寿县鼎盛生物工程有限公司 Heilongjiang Yanshou County Dingxin Bioengineering Co.Ltd	理事单位 Board member	张建东 ZHANG Jiandong	总经理 General Manager
27	黑龙江众源冬果沙棘开发有限责任公司 Heilongjiang Zhongyuan Dongguo Seabuckthorn Development Co.Ltd	理事单位 Board member	杜中元 DU Zhongyuan	董事长 Chairman
28	黑龙江省农业科学院 Heilongjiang Academy for Agricultural Science	理事单位 Board member	单金友 Shan Jinyou	研究员 Researcher
29	林下产业（黑龙江）有限公司 Sub-Forest Industry (Heilongjiang) Co., Ltd.	理事单位 Board member	丛志甲 Cong Zhijia	总经理 General Manager

30	上海沃迪智能装备股份有限公司 Shanghai Wodizineng Equipment Corporation	理事单位 Board member	王冲 WANG Chong	业务经理 Manager
31	四川星瑞健康产业集团有限公司 Sichuan Xingrui Health Industry Group Co., Ltd.	理事单位 Board Member	莫勇 Mo Yong	总经理 General Manager
32	陕西黄龙国寿堂生物工程有限公司 Shaanxi Huan-glong Guoshoutang Bioengineering Co. Ltd	理事单位 Board member	陈家顺 CHEN Jiashun	董事长 Chairman
33	清华德人西安幸福制药有限公司 Qinghua Deren Xi'an Xingfu Pharmaceutical Co. Ltd	理事单位 Board member	刘红娜 Liu Hongna	研究员 Researcher
34	兰州大学药学院 College of Pharmacy, Lanzhou University	理事单位 Board member	杨志刚 Yang Zhigang	副院长 Vice Dean
35	新疆景华天宝科技发展有限公司 Xinjiang Jinghua-tianbao Tech-development Co. Ltd	理事单位 Board member	刘佳羽 LIU Jiayu	总经理 General Manager
36	新疆疆果四季科技有限公司 Xinjiang Jiangguo Siji technology Co., Ltd	理事单位 Board member	步艳东 Bu Yandong	总经理 General Manager
37	新疆慧华沙棘生物科技有限公司 Xinjiang Huihua Seabuckthorn Bio-tech Co. Ltd	理事单位 Board member	蔡永国 CAI Yongguo	经理 Manager
38	新疆中科沙棘科技有限公司 Xinjiang Zhongke Sea-buckthorn Tech Co. Ltd	理事单位 Board Member	徐均 XU Jun	总经理 General Manager
39	中国农业科学院农业资源与农业区划研究所 Institute of Agricultural Resources and Zoning, CAAS	会员单位 Member	尤飞 YOU Fei	研究员 Researcher
40	山西山阳生物药业有限公司 Shanxi Shanyang Bio-Medicine Co. Ltd	会员单位 Member	姜瑞林 JIANG Ruilin	总经理 General Manager
41	山西维仕杰食品饮料有限责任公司 Shanxi Weishijie Food & Drink Co. Ltd	会员单位 Member	赵永卫 ZHAO Yongwei	董事长 Chairman
42	山西金科海生物科技有限公司 Shanxi Jinkehai Bio-tech Co. Ltd	会员单位 Member	郭海利 GUO Haili	董事长 Chairman
43	山西献果园生物科技有限公司 Shanxi Xiangguoyuan Bio-tech Co. Ltd	会员单位 Member	曹满 CAO Man	董事长 Chairman
44	山西葆源生物科技有限公司 Shanxi Baoyuan Bio-tech Co. Ltd	会员单位 Member	郭林宝 GUO Linbao	经理 Manager
45	山西恒义生物科技有限公司 Shanxi Hengyi Bio-tech Co. Ltd	会员单位 Member	许张兵 XU Zhangbing	总经理 General Manager
46	山西高原圣果沙棘生物有限公司 Shanxi Gaoyuanshengguo Seabuckthorn Biological Co. Ltd	会员单位 Member	武国昌 WU Guochang	总经理 General Manager

47	内蒙古万柳生态农业有限责任公司 Inner Mongolia Wangliu Eco-agriculture Co. Ltd	会员单位 Member	郭秋实 GUO Qiushi	董事长 Chairman
48	内蒙古大唐药业股份有限公司 Inner Mongolia Datang Pharmaceutical Co. Ltd	会员单位 Member	梁国栋 LIANG Guodong	总经理 General Manager
49	内蒙古吉文林业局 Inner Mongolia Jiwen Forestry Bureau	会员单位 Member	杨英新 YANG Yingxin	总经理 General Manager
50	内蒙古毕拉河林业局 Inner Mongolia Bilahe Forestry Bureau	会员单位 Member	杨静磊 YANG Jinglei	主任 Director
51	内蒙古库都尔林业局 Inner Mongolia Kuduer Forestry Bureau	会员单位 Member	王获玺 WANG Huoxi	主任 Director
52	内蒙古大杨树林业局 Inner Mongolia Dayangshu Forestry Bureau	会员单位 Member	王元成 WANG Yuancheng	主任 Director
53	内蒙古蒙鑫农林产业科技有限公司 Inner Mongolia Mengxin Agri-forestry Industrial Technical Co. Ltd	会员单位 Member	陈国香 CHEN Guoxiang	副总经理 Vice General Manager
54	内蒙古大沙棘实业(集团)有限公司 Inner Mongolia Big Seabuckthorn Industrial Co. Ltd	会员单位 Member	陈羿达 CHEN Yida	总经理 General Manager
55	内蒙古蒙鑫农林产业科技有限公司 Inner Mongolia Mengxin Agriculture and Forestry Industry Technology Co., Ltd.	会员单位 Member	高玉琼 Gao yuqiong	总经理 General Manager
56	中国内蒙古森工集团阿尔山森林工业有限公司 China Inner Mongolia Forest Industry Group Alshan Forest Industry Co. LTD	会员单位 Member	徐成才 Xu Chengcai	总经理 General Manager
57	吉林修养堂药业保健品有限公司 Jilin Qiuyangtang Pharmaceutical & Healthcare Product Co. Ltd	会员单位 Member	李晓光 LI Xiaoguang	董事长 Chairman
58	吉林省富智达生态科技发展有限公司 Jinlin Fuzhida Eco-tech Development Co. Ltd	会员单位 Member	刘杰 LIU Jie	经理 Manager
59	黑龙江省长乐山大果沙棘开发有限公司 Heilongjiang Changleshan Seabuckthorn Devel- opment Co. Ltd	会员单位 Member	王忠校 WANG Zhongxiao	董事长 Chairman
60	黑龙江延寿县御禄园茶业有限公司 Heilongjiang Yan-shou Yuluyuan Tea Industry Co. Ltd	会员单位 Member	李承捷 LI Chengjie	董事长 Chairman
61	黑龙江盛农食品有限公司 Heilongjiang Shengnong Food Co. Ltd	会员单位 Member	姚忠华 YAO Zhonghua	董事长 Chairman
62	黑龙江牡丹江东安区康利果蔬农民专业合作社 Mudanjiang Donganqu Kangli Fruit & Vegetable Farmer Cooperative	会员单位 Member	邵珠宽 SHAO Zhukuan	经理 Manager
63	上海高原圣果实业有限公司 Shanghai Gaoyuanshengguo Industry Co. Ltd	会员单位 Member	汤顺新 TANG Shunxin	董事长 Chairman

64	江苏常州燕和堂商贸有限公司 Changzhou Yanhetang Trade Co. Ltd	会员单位 Member	陈从梅 CHEN Congmei	董事长 Chairman
65	江苏扬州福尔喜果蔬汁机械有限公司 Yangzhou Fuerxi Fruit & Vegetable Juice Machinery Co.Ltd	会员单位 Member	许荣华 XU Ronghua	董事长 Chairman
66	浙江杭州沙美生物科技有限公司 Hangzhou Shamei Bio-tech Co. Ltd	会员单位 Member	李云天 LI Yuntian	经理 Manager
67	浙江宁波元硕生物科技开发有限公司 Ningbo Yuanshuo Bio-tech Co. Ltd	会员单位 Member	赵晓峰 ZHAO Xiaofeng	总经理 General Manager
68	山东清香茗泽农业科技有限公司 Shandong Qingxiangmingze Agri-tech Co. Ltd	会员单位 Member	于海洋 YU Haiyang	总经理 General Manager
69	山东菏泽中禾健元生物科技有限公司 Shandong Heze Zhonghehe Jianyuan Bio-Tech Co. Ltd	会员单位 Member	储文宾 CHU Wenbin	总经理 General Manager
70	河南胜景堂生物科技有限公司 Henan Shengjingtang Bio-tech Co. Ltd	会员单位 Member	韩宜冬 HAN Yidong	董事长 Chairman
71	四川成都川大华西保健品有限公司 Sichuan Chengdu Chuanda Healthcare Product Co. Ltd	会员单位 Member	黄祥芳 HUANG Xiangfang	经理 Manager
72	陕西西林兔药业 Shanxi Erlintu Pharmaceutical Co. Ltd	会员单位 Member	李勇建 LI Yongjian	总经理 General Manager
73	甘肃甘农生物科技有限公司 Gabsu Gannong Bio-tech Co. Ltd	会员单位 Member	傅雨萌 FU Yumeng	经总经理 General Manager
74	甘肃艾康沙棘制品有限公司 Gansu Aikang Seabuckthron Co. Ltd	会员单位 Member	马静 MA Jing	总经理 General Manager
75	青海久实虫草生物科技有限公司 Qinghai Jlushichongcao Bio-tech Co. Ltd	会员单位 Member	曾静 ZENG Jing	经理 Manager
76	青海清华博众生物技术有限公司 Qinghai Qinghua Bozhong Bio-tech Co. Ltd	会员单位 Member	费楠 FEI Nan	总经理 General Manager
77	青海安旭生物科技集团有限公司 Qinghai Anxu Bio-tech Co. Ltd	会员单位 Member	马安成 MA Ancheng	经理 Manager
78	青海伊纳维康生物科技有限公司 Tangut (CHINA) Co Ltd	会员单位 Member	董树林 DONG Shulin	副总经理 Vice General Manager
79	宁夏隆馨闽宁助残商贸中心 Ningxia Longsu Minningzhucan Trade Center	会员单位 Member	辛同宝 XIN Tongbao	总经理 General Manager
80	新疆西域珍品生物科技有限公司 Xinjiang Xiyuzhenpin Bio-tech Co. Ltd	会员单位 Member	李婧 LI Jing	总经理 General Manager

81	新疆乌苏市佳禾畜牧科技有限公司 Xinjiang Wusu Jiaohu Livestock-tech Co. Ltd	会员单位 Member	宋悦恒 SONG Yueheng	经理 Manager
82	新疆吉盛元沙棘生物科技有限公司 Xinjiang Jishengyuan Bio-tech Co. Ltd	会员单位 Member	陶桐生 TAO Tongsheng	经理 Manager
83	新疆先农伯益生物科技有限公司 Xinjiang Xiannong Boyi Biotechnology Co., Ltd	会员单位 Member	赵军丰 ZHAO Junfeng	总经理 General Manager
84	新疆清雅丰健康科技有限公司 Xinjiang Qingyafeng Health Tech Co. Ltd	会员单位 Member	田丰 TIAN Feng	董事长 Chairman
85	新疆青河县隆濠科技发展有限公司 Xinjiang Qing-he County Longhao Bio-tech Co. Ltd	会员单位 Member	孙文胜 SUN Wensheng	总经理 General Manager
86	新疆一七零团丝路沙棘生物科技有限公司 Xinjiang 170 Tuan Silk Road Seabuckthorn Bio-technology Co., Ltd.	会员单位 Member	王军扬 WANG Junyang	总经理 General Manager
87	新疆阿勒泰太阳石健康产业发展有限公司 Altay Sunstone Health Industry Development Co., LTD	会员单位 Member	邓惠中 DENG Huizhong	总经理 General Manager
88	新疆布尔津县松源林果生物科技有限公司 Burjin Songyuan Linguo Biotechnology Co., Ltd	会员单位 Member	靳慧林 JIN Huilin	董事长 Chairman
89	新疆戈壁记忆品牌管理有限公司 Xinjiang Gobi Memory Brand Management Co., Ltd.	会员单位 Member	张文莉 Zhang Wenli	董事长 Chairman
90	新疆喀纳斯亿嘉康生物科技有限公司 Xinjiang Kanas Yijiakang Biotechnology Co., Ltd	理事单位 Board Member	彭正荣 Peng Zhengrong	经理 General Manager
91	新疆昆仑天和国际贸易有限公司 Xinjiang Kunlun Tianhe International Trade Co., Ltd.	理事单位 Board Member	蒋剑飞 Jiang Jianfei	总经理 General Manager
92	布尔津县松源林果生物科技有限公司 Burjin Songyuan Linguo Biotechnology Co., Ltd	会员单位 Member	靳慧林 JIN Huilin	董事长 Chairman
93	新疆金圣果农业专业合作社 Xinjiang Jinshengguo Agricultural Professional Cooperative	会员单位 Member	赵军丰 ZHAO Junfeng	总经理 General Manager
94	黑龙江金科沙棘有限公司 Heilongjiang Jinke Sea-buckthorn Co. LTD	会员单位 Member	王忠国 Wang Zhongguo	董事长 Chairman
95	牡丹江市大棘生物科技有限公司 Mudanjiang Daji Biotechnology Co., Ltd.	会员单位 Member	刘宇航 Liu Yuhang	总经理 General Manager
96	纯真时代生物科技(广州)有限公司 Innocence Times Biotechnology (Guangzhou) Co., Ltd	会员单位 Member	关伟 GuanWei	董事长 Chairman

6. Introduction of important activities, major events, successful stories in the country in the year of 2021.

6.1 International Cooperation

Currently, China has initially established collaboration with Russia, Germany, France, Greece, UK, Latvia, Romania, Finland, Sweden, Mongolia, Japan, North Korea, India, Nepal, Pakistan, Kyrgyzstan, Iran, Canada, USA, Chile, Peru, Bolivia, and other countries. And once won the World Bank, the United Nations Development Programme, the European Union, Pero Fund of the Group 77, and International Centre for Integrated Mountain Development of technical and financial supports, technology cooperation and economic cooperation on seabuckthorn with other countries have been carried out each year.

Chinese government attaches great importance to ecological progress and has put forward the "Belt and Road" development strategy. Seabuckthorn is a kind of efficient soil and water conservation plant, which can improve ecological environment construction and promote economic development. Seabuckthorn has great ecological value and economic value. It is the good opportunity for seabuckthorn development in conjunction with the "Belt and Road" strategy, to promote bilateral and multilateral seabuckthorn exchanges and cooperation. Along the Belt and Road related to 65 countries and regions globally, more than a dozen countries, including Russia, Mongolia, Kazakhstan, Tajikistan, Uzbekistan, Iran, India, Nepal, Pakistan, Germany, Finland, Latvia, etc. have a solid base for seabuckthorn cultivation and industrial development.

International Seabuckthorn Association as an international non-governmental, non-profit organization, and with members from seabuckthorn enterprises, research institutes and individuals was proposed by international seabuckthorn experts from China, Germany, Russia, Finland, India,

6. 2021 年全国有关沙棘的重要活动、重大事 项介绍

6.1. 国际合作开展情况

目前,中国已初步建立了与俄罗斯、德国、英国、法国、希腊、拉脱维亚、罗马尼亚、芬兰、瑞典、蒙古、日本、朝鲜、印度、尼泊尔、巴基斯坦、吉尔吉斯斯坦、伊朗、加拿大、美国、智利、秘鲁、玻利维亚等国家的合作联系,并曾经获得了世界银行、联合国开发署、欧盟、77国集团佩罗基金、国际山地综合开发中心等国际组织的技术和资金支持,每年与各国开展沙棘科技交流或经济合作。

中国政府高度重视生态文明建设,提出“一带一路”倡议。沙棘是一种高效的水土保持植物,可以改善生态环境建设,促进经济发展。沙棘具有巨大的生态价值和经济价值。我们必须抓住政策上的重大机遇,特别是与“一带一路”建设相结合,推动双边和多边沙棘国际交流与合作。在“一带一路”相关的65个国家和地区中,有十多个国家(包括俄罗斯、蒙古、哈萨克斯坦、塔吉克斯坦、乌兹别克斯坦、伊朗、印度、尼泊尔、巴基斯坦、德国、芬兰、拉脱维亚等)已经开展沙棘种植和产业发展,具备一定的基础条件。

国际沙棘协会是由中国、德国、俄罗斯、芬兰等国专家于2001年发起成立,由全球积极开展沙棘研究与开发的企事业单位、个人和其他组织自愿组成的学术性、行业性国际非政府、

etc. and launched in 2001. And in 2011, ISA was approved by the Chinese Ministry of Foreign Affairs and Ministry of Water Resources and then officially certificated by Ministry of Civil Affairs.

On October 15, 2019, at the General Assembly of International Seabuckthorn Association held in Berlin, Germany, 14 members from 7 countries, including China, Germany, Russia, Finland, Latvia, India and Canada, were elected as the second board of directors. Mr. ZHAO Dongxiao, Director General of Management Center for Sea-buckthorn Development, Ministry of Water Resources, and Mr LU Shunguang, Deputy Director General were elected as Chairman and Secretary General of International Sea-buckthorn Association respectively. Mr. Veli-markku Korteniemi from Finland, Jorg-Thomas Morsel from Germany and Yury A. Zubarev from Russia were elected as Vice Chairmen respectively. Professor Baoru YANG from Turku University, Finland was elected as the new Chairperson of Scientific Committee of International Seabuckthorn Association. (See in detailed in Table 4)

On July 15 of 2021, the Fifth Meeting of the Second Board of International Seabuckthorn Association (ISA) was held by ZOOM Video. The central topic is review the progress report of the preparation for 9th ISA Conference presented by Mr. Nikos Doukas, the Local Organizer. The meeting was Chaired by Zhao Dongxiao, Chairman of ISA. Each of ISA Board members attended the meeting and gave his comments and suggestions. The conclusion remark was made by Prof. (Henry) LU Shunguang, Secretary General of ISA. After full discussion and review, the main conclusions have been reached as follow:

A. The participating ISA Board members expressed satisfaction with and gratitude to the preparation progress made by Greek colleagues, the Local Organizing Committee (LOC) of ISA2022, and all showed full confidence in the success of the conference.

非营利组织,是经中国外交部同意、水利部批准,于2011年在中国民政部正式注册、第27个总部设在中国的国际性社团机构。

2019年10月15日,在德国柏林召开的国际沙棘协会会员代表大会上,选举产生了由来自中国、德国、俄罗斯、芬兰、拉脱维亚、印度、加拿大等7个国家的14名成员组成的第二届理事会。在随后召开的国际沙棘协会第二届理事会第一次会议上,水利部沙棘开发管理中心时任主任赵东晓、副主任卢顺光分别当选为国际沙棘协会理事会主席、秘书长。来自芬兰的Veli-Markku Korteniemi、德国的Jörg-Thomas Mörsel、俄罗斯的Yury A. Zubarev分别当选为副主席(详见附表4)。芬兰图尔库大学杨宝茹Baoru YANG教授当选为新一届国际沙棘协会科技委员会主席。

2021年7月,国际沙棘协会理事会通过电子邮件方式举行了二届二次会议,讨论同意原定于2020年5月在希腊举办的第九届国际沙棘大会推迟到2022年5月。会议由国际沙棘协会主席、中国水利部沙棘开发管理中心主任赵东晓先生主持,14名理事均在线出席会议并提出意见建议,国际沙棘协会秘书长、中国水利部沙棘开发管理中心副主任卢顺光作了大会总结发言。会议取得以下主要成果。

(1) 第九届国际沙棘大会主办方代表 Nikos Doukas 先生通过多媒体向理事会详细报告了大会筹办工作最新进展和近期工作计划。大家对大会筹办工作表示满意,对希腊同行所作的努力表示敬意,对成功举办大会充满信心!

B. Since there are less than 10 months left to the opening of ISA2022 (scheduled on May 2022), the LOC is asked to make sure of the venue, technical visit, accommodation for participants, meeting agenda etc. and then circulate the new announcement to invite global seabuckthorn experts to the ISA2022.

C. In view of the existing global epidemic of COVID-19 and continuing uncertainty in hosting of ISA2022, the LOC of Greece is required to have an alternative plan for on-line conference, which is hosted by ISA, in case of restriction of international travels or meetings.

D. For the success of ISA2022, each member of ISA/SCISA is requested to join more efforts and supports to LOC to actively overcome the negative impact of global COVID-19 pandemic, call for submission of more scientific papers and new participants to ISA2022. The Secretariat of ISA is asked to maintain contact and coordination with Mr. Nikos Doukas regarding necessary timely arrangements of the conference mentioned as discussed at this Board meeting. Any urgent issue should be informed to and discussed with ISA Board.

6.2 Important activities, major events happened nationally and internationally in the year of 2021

A. In January, at the request of European Seabuckthorn Society and proposal from ISA, International seabuckthorn experts joined the Work Group for Seabuckthorn Fly (*Rhagoletis batava*) Control.

B. In January, 2021 annual meeting for National Seabuckthorn Breeding Network was hosted by Management Center for Seabuckthorn Development (MCSD), Ministry of Water Resources.

(2) 鉴于目前离计划于 2022 年 5 月召开的第九届国际沙棘大会还有不到 10 个月时间，希望大会组办方进一步落实会场、会间考察、会议时间安排、参会代表住宿宾馆等具体事项后，发布新一轮会议通知，邀请全球沙棘专家出席第九届国际沙棘大会。

(3) 由于目前新冠疫情仍然在全球流行，对能否举办 ISA2022 线下大会带来不确定性。希望大会组办方做好预案，一旦无法举办线下会议，应组织举办线上会议。

(4) 会议要求国际沙棘协会理事会 / 技术委员会全体成员，继续给予希腊同行更大的支持，努力克服全球新冠肺炎疫情带来的不利影响，组织各国沙棘专家报名、投稿并前往希腊参加大会，通过大家共同努力，把第九届国际沙棘大会办成又一次成功的国际大会。请秘书处继续做好与希腊会议承办方 Nikos 先生的协调联系，具体落实各位理事所关心的有关事项，并就相关重大问题向理事会报告和讨论决策。

6.2. 2021 年全国 / 全球重大沙棘事件

(1) 2021 年 1 月，应欧洲沙棘协会请求，由国际沙棘协会倡议，全球沙棘科学家联合开展沙棘果蝇 (*Rhagoletis batava*) 防治对策研究。

(2) 2021 年 1 月，水利部沙棘中心举办全国沙棘育种协作网 2020 年工作总结及 2021 年工作安排会议。

C. In February, H.E. Mr. LU Guihua, Vice Minister of Water Resources, sent his greeting and requirement to 2021 Workplan of International Seabuckthorn Association.

D. In March, MCSD hosted achievement in title of Cross breeding and application of new super seabuckthorn varieties of high yield and good adaptability was honored the Grade II Scientific Prize by Chinese Society for Soil and water Conservation.

E. In March, 7 new institutes namely Shanxi Provincial Academy for Forestry and Grassland Sciences, Liaoning Provincial Institute for Dry Land Agro-forestry Research, Dalian Minzu University, Heilongjiang Provincial Academy for Agricultural Sciences, Shanghai Wode Smart Equipment Co. Ltd, Qinghua Deren Xi'an Xingfu Pharmaceutical Co. Ltd, Pharmaceutical College of Lanzhou University, joined Enterprise Committee (China) of International Seabuckthorn Association (ISA) as Board Members.

F. In April, MCSD hosted achievement in title of A blended seabuckthorn drink and its processing method was honored the Certificate of National Invention Patent by State Intellectual Property Bureau.

G. In April, MCSD hosted technical training in title of High performance seabuckthorn plantation and deep utilization was organized in Yanan, Shanxi province with over 130 trainee.

H. In May, 4 ISA standards, namely Seabuckthorn Seed oil, Seabuckthorn Pulp Oil, Seabuckthorn Raw Juice, Seabuckthorn Proanthocyanidins were issued by the Secretariat of ISA.

I. In June, Dr. RUAN Chengjiang from Dalian

(3) 2021年2月,水利部副部长陆桂华对“国际沙棘协会2020年工作总结和2021年工作计划”作出重要批示。

(4) 2021年3月,由水利部沙棘开发管理中心主持的“广适优质高产沙棘杂交新品种选育与应用”成果荣获中国水土保持学会科学技术二等奖。

(5) 2021年3月,国际沙棘协会(中国)企业委员会新增7个理事单位:山西省林业和草原科学研究院、辽宁省旱地农林研究所、大连民族大学、黑龙江省农科院乡村振兴研究所、上海沃迪智能装备股份有限公司、清华德人西安幸福制药有限公司、兰州大学药学院。

(6) 2021年4月,由水利部沙棘开发管理中心主持的“一种沙棘果汁复合饮料及其制备方法”获得国家知识产权局颁发的国家发明专利证书。

(7) 2021年4月,水利部沙棘开发管理中心在陕西延安举办了“高效沙棘资源建设及深度开发利用培训班”,培训130多人。

(8) 2021年5月,国际沙棘协会审议批准《沙棘籽油》《沙棘果油》《沙棘原果汁》《沙棘籽原花青素》4项新的团体标准。

(9) 2021年6月,国际沙棘协会科技委员会新增两名沙棘科学家:来自巴基斯坦AJ克什米尔大学的阿萨德·胡赛因·沙哈(Asad

Minzhu University, PR CHINA and Dr. Asad Hussain Shah from University of Azad Jammu and Kashmir, Pakistan joined Scientific Committee of ISA as SCISA members.

J. In June, Jointly hosted by German Seabuckthorn Society, Latvian Seabuckthorn Union and Federal Altai Scientific Center of Agro-biotechnologies, Russia, an international platform namely EuroWorks on Air (<https://euoworks.online/wp/>) was initiated for academic exchanges.

K. In June, the online Annual National Seabuckthorn Workshop was held by jointly hosted by MCSD and ISA.

L. In July, 2021 Annual ISA Board Meeting was held online. It was decided to postpone the 9th ISA Conference again to be held in May of 2022 in Greece.

M. In August, a publication namely Festschrift for 35 Years Seabuckthorn Development in China was issued by MCSD.

N. In August, a typical Seabuckthorn Hotpot was promoted by Haidilao Catering Co.Ltd joined with Ant Forest, a non-profit platform subsidized by Ali Pay.

O. In October, the 20th Anniversary for China Aid Bolivia Seabuckthorn Planting Demonstration Project was organized by MCSD.

P. In October, Mr Choe Hui Bom, Counsellor of Embassy of DPR Korea to Beijing, paid a visit to MCSD and ISA Secretariat. The feasibility to introduce successful experiences of seabuckthorn

Hussain Shah) 博士和来自我国大连民族大学的阮成江教授。

(10) 2021 年 6 月, 由德国沙棘协会、拉脱维亚沙棘协会和俄罗斯联邦阿尔泰农业生物技术科学中心联合运营的欧洲沙棘云服务网 EuroWorks on Air 成功上线, 并先后举办了 4 次线上国际学术研讨会, 我国多位沙棘知名专家参加研讨。

(11) 2021 年 6 月, 水利部沙棘开发管理中心联合国际沙棘协会在线上举办 2021 年度全国沙棘学术交流会议。

(12) 2021 年 7 月, 国际沙棘协会第二届理事会第五次会议在线上成功召开, 决定第九届国际沙棘协会大会再次延期至 2022 年 5 月在希腊举办。

(13) 2021 年 8 月, 水利部沙棘开发管理中心编辑出版了《全国沙棘开发 35 周年纪念文集》。

(14) 2021 年 8 月, 全国知名连锁餐饮企业“海底捞”联名蚂蚁集团旗下支付宝公益平台“蚂蚁森林”推出沙棘火锅。

(15) 2021 年 10 月, 水利部沙棘中心庆祝实施中国援助玻利维亚沙棘示范种植项目 20 周年。

(16) 2021 年 10 月, 朝鲜驻华使馆参赞崔希范一行访问国际沙棘协会, 双方就在朝鲜合作

planting and product development in China to PR Korea was fully discussed.

Q.In November, the Annual Report of International Seabuckthorn Development for the Year of 2020 was jointly published by ISA and MCSD

R.In November, two scientific achievements hosted by MCSD joined by Shenyang Agricultural University in titles of Response mechanism of seabuckthorn to drought stress and regulative function of calcium application, Research on seabuckthorn wilting aetiology and in application of prevention and control technology, were evaluated with world leading level.

S.In December, MCSD hosted national scientific research project in title of Research on high performance seabuckthorn plantation construction and its industry technology in water and wind conjunctive erosion regions passed the evaluation.

T.Because of the national wide yield reduction, the price for seabuckthorn fresh berries increased significantly in fall and winter of 2021, compared with that in 2020.

U.Many member enterprises of Enterprise Committee (China) of International Seabuckthorn Association (ISA) fulfilled their social duties to serve the pandemic control of Covid-19 by contributing more than 10,000.000 RMB Yuan in kind.

推广中国的沙棘种植与产品加工经验等进行深入研讨。

(17) 2021年11月, 由国际沙棘协会联合水利部沙棘开发管理中心编辑发行了《2020年国际沙棘发展报告》(中英文)。

(18) 2021年11月, 由水利部沙棘开发管理中心和沈阳农业大学共同完成的两项成果“沙棘对干旱胁迫的响应机制及外源施钙调控效应”“沙棘枝枯病病原学及防控技术研究与应用”通过了科技成果评价, 项目整体达到了“国际领先”水平。

(19) 2021年12月, 由水利部沙棘开发管理中心承担的国家重点研发计划“水蚀风蚀交错区高效沙棘林构建和产业化技术研究”专题顺利通过验收。

(20) 受我国沙棘主产区果实普遍减产因素影响, 2021年秋冬季节沙棘鲜果收购价格比上一年明显增长。

(21) 国际沙棘协会众多会员企业积极履行社会责任, 继续支持当地新冠肺炎疫情防控工作, 2021年累计捐款捐物1000多万元。



Table.4. Name-list for Board Members of International Seabuckthorn Association
表 4. 国际沙棘协会理事会成员名单

序号	姓名 name	性别 Sex	国家 Country	工作单位 Employed Institution	职务 Title	在协会的任职 Title in ISA
1	赵东晓 Zhao Dongxiao	男 M	中国 China	水利部沙棘开发管理中心 Management Center for Sea- buckthorn Development, Ministry of Water Resource	主任 Director General	主席、理事 Chairman
2	维里·马尔库·科特涅米 Veli-Markku Kortenieni	男 M	芬兰 Finland	Aromtech 有限公司 Aromtech Ltd	总经理 General Manager	副主席、理事 Vice Chairman
3	约尔·托马斯·莫塞尔 Jörg-Thomas Mörsel	男 M	德国 Germany	UBF 有限公司 UBF Ltd	首席执行官 CEO	副主席、理事 Vice Chairman
4	尤里·祖巴列夫 Yury A. Zubarev	男 M	俄罗斯 Russia	西伯利亚利萨文科园艺研究所 Lisavenko Research Institute of Horticulture for Siberia	高级研究员 Senior Researcher	副主席、理事 Vice Chairman
5	吕荣森 Lu Rongsen	男 M	中国 China	中国科学院成都生物研究所 Biology Insitute, Chinese Acad- emy of Science	教授 Professor	理事 Board member
6	维伦德拉·辛格 Virendra Singh	男 M	印度 India	喜马偕尔邦农业大学 CSK Himachal Pradesh Agricul- tural University	教授, 印度沙棘协会秘书长 Professor	理事 Board member
7	莫沫 Mo Mo	男 M	中国 China	水利部水土保持司 Dep. of Soil and Water Conser- vation	原副司长 Deputy Director General	理事 Board member
8	杨宝茹 Yang Baoru	女 F	芬兰 Finland	图尔库大学 University of Turku	教授, 食品科学系主任 Professor, Head of Dept. of Food Science	理事 Board member
9	达里加 瑟格丽娜 Dalija Seglina	女 F	拉脱维亚 Latvia	拉脱维亚园艺研究所 Institute of Horticulture, Latvia	加工生化部主任 Head of Unit of Pro- cessing and Bio- chemistry	理事 Board member
10	纳塔莉亚·杰米多娃 Natalia Demidova	女 F	俄罗斯 Russia	俄罗斯北方林业研究所 Northern Research Institute of Forestry	科学部副主任 Deputy Director on Sciences	理事 Board member
11	安德烈·布鲁威利斯 Andrejs Bruvelis	男 M	拉脱维亚 Latvia	拉脱维亚沙棘协会 Seabuckthorn Association of Latvia	主席 Head	理事 Board member
12	阿尔芬斯·乌提欧 Al- phonsus Utioh	男 M	加拿大 Canada	食品研发中心 Center for Food Research and Development	高级研究员 Senior Reseacher	理事 Board member
13	卢顺光 Lu Shunguang	男 M	中国 China	水利部沙棘开发管理中心 Management Center for Sea- buckthorn Development, Ministry of Water Resource	副主任 Deputy Director General	秘书长、理事 Secretary Gen- eral
14	夏静芳 Xia Jingfang	女 F	中国 China	水利部沙棘开发管理中心 Management Center for Sea- buckthorn Development, Ministry of Water Resource	处长 Division Chief	副秘书长、理事 Deputy Secre- tary General

7. Policies and documents related with seabuckthorn, and research papers in the year of 2021 in the country.

7.1. In October, hosted by Management Center for Seabuckthorn Development (MCSD), Ministry of Water Resources, The Annual Report of Seabuckthorn Development in China for the Year of 2020 was published. The details covering 17 provinces/autonomous regions of China, in terms of seabuckthorn plantation resources, berry yield, product and marketing, R&D, scientific papers and publication, human resources, etc., were included and analyzed in the report.

7.2. According to data of Baidu Search, in total 142 scientific articles on seabuckthorn were published by Chinese scientists/researchers at Chinese professional journals in 2021. See the detailed as in Appendix: Scientific articles/papers/thesis on seabuckthorn published in the year of 2021 in China.

7. 2021年全国颁布有关沙棘的主要政策文件、技术标准，发表研究论文等

7.1. 2021年10月，水利部沙棘开发管理中心编辑出版了《2020年度中国沙棘开发报告》，统计和分析了全国17个省（自治区、直辖市）沙棘资源种植、果实产量、产品加工与销售、科学研究、论文专著、从业人员等基本数据。

7.2. 全国沙棘专家共发表沙棘论文或相关文章142篇（数据来源于百度学术、知网）。详见附件：2021年度中国学者发表的沙棘科技论文。





新品种“蒙中黄”
(*Hippophae rhamnoides* ssp. *monglica-sinensis* “Mengzhonghuang”)



新品种“蒙中红”
(*Hippophae rhamnoides* ssp. *monglica-sinensis* “Mengzhonghong”)



新品种“达拉特”
(*Hippophae rhamnoides ssp. monglica-sinensis* “Dalate”)



新品种“蒙中雄”
(*Hippophae rhamnoides ssp. monglica-sinensis* “Mengzhongxiong”)



新品种“俄中黄”
(*Hippophae rhamnoides* ssp. *monglica-sinensis* “Ezhonghuang”)



新品种“俄中鲜”
(*Hippophae rhamnoides* ssp. *monglica-sinensis* “Ezhongxian”)

Appendix : Scientific articles/papers/thesis on seabuckthorn published in the year of 2021 in China

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2. LIU Y.C. ZHANG J.Q., Processing technology optimization of seabuckthorn pulp oil extraction and its fatty acids measurement, Chinese Food Additives, 2021(12)
3. GE L., LI N., YANG M.H. et al, Efficient Thin-layer Chromatography analysis and anti-oxidant capacity research on seabuckthorn berries, Foods and Fermentation Industry, 2021(12)
4. HU J.Z., ZHANG B.O Y., Analysis of flavonoids content of natural seabuckthorn berries in China, Qinghai Agro-Forestry Science and Technology, 2021(12)
5. ZHANG X.Y., LIU J.H., CHANG R.X, et al, Research progress of seabuckthorn function and its developing prospect, Chinese Fruit and Vegetable, 2021(12)
6. SHI F., QIAO Y.J., NG J., Impact of different fermentation technologies to the quality and aroma of seabuckthorn wine, Journal of Shanxi Agricultural University, 2021(12)
7. LV Z.R., LIU H., ZHANG G.J., et al, Genomewide identification and expressing analysis of seabuckthorn UGT genetic family, Forestry Science Research, 2021(12)
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附件：2021 年度中国学者发表的沙棘科技论文

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2. Country Report of Finland



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Sea Buckthorn Research and Development in Finland in 2021

2021 年芬兰的沙棘研究和发展

In Finland, there were active developments in research, cultivation, industrial processing and utilization of sea buckthorn. In addition, pilot effort initiated by the University of Turku has been on-going to use sea buckthorn in protection of the Baltic sea ecosystem. TYRNIRAKI project continued in 2021 and will continue in 2022 and onwards. A plantation was established in Utsjoki in 2021. New development has happened in commercial plantation and processing of sea buckthorn in Finland.

在芬兰，沙棘开发主要涉及科研、种植、工业加工和利用。此外，2020年由图尔库大学发起了一个利用沙棘保护波罗的海生态系统的试点项目：TYRNIRAKI。该试点项目工作于2021年继续进行，并将于2022年及以后继续。2021年，我们还在乌茨约基建立了一个种植园。芬兰在沙棘的商业性种植和加工方面有了新的发展。



Research

科研方面

University of Turku (UTU) has been a leading institute in the research on sea buckthorn in Finland. The research on sea buckthorn has been active, and seven peer-reviewed papers were published in internationally leading scientific journals in 2021 based the long-term continuous sea buckthorn research.

图尔库大学 (UTU) 是芬兰沙棘研究的领先机构。关于沙棘的研究一直很活跃，基于芬兰沙棘的长期连续研究，2021年有7篇同行评议论文发表在国际领先的科学期刊上。

1. Markkinen N, Pariyani R, Jokioja J, Kortensniemi M, Laaksonen O, Yang B. (2021) Impact of fermentation with *Lactobacillus plantarum* on metabolomics of sea buckthorn (*Hippophaë rhamnoides*) juice. Food Chem. <https://doi.org/10.1016/j.foodchem.2021.130630>

1. Markkinen N, Pariyani R, Jokioja J, Kortensniemi M, Laaksonen O, Yang B., 沙棘果汁与 *Lactobacillus plantarum* 植物乳杆菌发酵对代谢组学的影响。食品化学 Food Chem. (2021)。 <https://doi.org/10.1016/j.foodchem.2021.130630>

Modern NMR-metabolomics method was applied to optimized the malolactic fermentation process on sea buckthorn juice. The metabolic pathways of the lactic acid bacteria under different fermentation conditions were studied.

2. Kalpio M, Fabritius M, Linderborg K, Kallio H, Yang B. (2021) Targeted strategy for stereospecific characterization of natural triacylglycerols using chiral chromatography and mass spectrometry. *J. Chromatography A*.
<https://doi.org/10.1016/j.chroma.2021.461992>

Sea buckthorn pulp oil was used as a model oil for developing the analytical strategy for determining the stereoisomers of triacylglycerols.

3. Beltrame G, Hemming J, Willför S, Han Z, Yang B. (2021) Supplementation of sea buckthorn press cake on mycelium growth and polysaccharides of *Inonotus obliquus* in submerged cultivation. *J. Appl. Microbiol.* <https://doi.org/10.1111/jam.15028>

Sea buckthorn press residues were applied as a growth promoter for cultivation of *Inonotus obliquus* to increase the growth and yield of bioactive polysaccharides.

4. Pap N, Fidelis M, Reshamwala D, Korpinen R, Kilpelainen P, Sant'Ana AS, Furtado MM, Wen M, Zhang L, Hellström J, Marnilla P, Mattila P, Sarjala T, Yang B, Azevedo L, Marjomäki V, Granato D (2021) Valorization of blackcurrant press cake, sea buckthorn leaves and bark from Scots pine and Norway spruce under a green integrated approach allied to bioactivities. *Food Chem. Toxicol.* 153, 112284.

主要研究内容: 应用现代核磁共振代谢组学方法对苹果乳酸进行优化, 研究沙棘汁的发酵工艺、乳酸的代谢途径, 对不同发酵条件下的细菌进行了研究。

2. M, Fabritius M, Linderborg K, Kallio H, Yang B., 天然三酰甘油的色谱立体特异性表征和质谱分析。色谱法 *J. Chromatography A*. (2021)。 <https://doi.org/10.1016/j.chroma.2021.461992>

主要研究内容: 以沙棘浆油为模型油, 制定分析策略, 三酰甘油立体异构体的测定。

3. Beltrame G, Hemming J, Willför S, Han Z, Yang B., 沙棘压榨残渣对印楝 *Inonotus obliquus* 褐孔菌菌丝生长及多糖的影响。应用微生物学 *J. Appl. Microbiol.* (2021)。 <https://doi.org/10.1111/jam.15028>

主要研究内容: 采用沙棘压榨残渣作为生长促进剂, 对印楝 *Inonotus obliquus* 进行培育, 增加生物活性多糖的生长和产量。

4. Pap N, Fidelis M, Reshamwala D, Korpinen R, Kilpelainen P, Sant'Ana AS, Furtado MM, Wen M, Zhang L, Hellström J, Marnilla P, Mattila P, Sarjala T, Yang B, Azevedo L, Marjomäki V, Granato D, 绿色综合方法评价黑醋栗压榨饼、沙棘叶、苏格兰松和挪威云杉树皮的生物活性应用。食品化学 *Food Chem. Toxicol.* (2021), *Toxicol*, 153,112284.

Green valorization method were developed for sea buckthorn leaves and the bioactivities of the extracts were studied.

5. Pap N, Fidelis M, Luciana Azevedo L, Vieira do Carmo MA, Wang D, Mocan A, Silva J, Sant'Ana A, Yang B, Granato D (2021) Berry polyphenols and human health: evidence of antioxidant, anti-inflammatory, microbiota modulation, and cytoprotecting effects. *Cur. Opin. Food Sci.*, <http://dx.doi.org/10.1016/j.cofs.2021.06.003>

Polyphenols of sea buckthorn berries together with phenolics from other berries were studied as bioactive ingredients.

6. Tian Y, Yang B (2021) Phenolic compounds in Nordic berry species and their application as potential natural food preservatives. *Critic. Rev. Food Sci. Nutri.* <https://doi.org/10.1080/10408398.2021.1946673>

The potential of sea buckthorn and other Nordic berry species as raw materials for natural food preservatives were reviewed.

7. Markkinen N, Laaksonen O, Yang B (2021) Impact of fermentation with *Lactobacillus plantarum* on volatile compounds of sea buckthorn (*Hippophaë rhamnoides*) juice. *Eur. Food Res. Technol.* DOI: 10.1007/s00217-020-03660-3

Malolactic fermentation was studied as a technology for modifying the composition and sensory properties of sea buckthorn juice. In this

主要研究内容:建立了沙棘叶片绿色价定方法,对提取物的生物活性进行了研究。

5. Pap N, Fidelis M, Luciana Azevedo L, Vieira do Carmo MA, Wang D, Mocan A, Silva J, Sant'Ana A, Yang B, Granato D, 浆果多酚与人类健康:具有抗氧化、抗炎、调节微生物和保护细胞的作用。当代食品科学观点 *Cur. Opin. Food Sci.*, (2021)。 <http://dx.doi.org/10.1016/j.cofs.2021.06.003>

主要研究内容:沙棘和其他浆果中的多酚类物质作为生物活性成分的研究。

6. Tian Y, Yang B, 北欧浆果中酚类化合物及其在潜在天然食品防腐剂中的应用。食品科学营养评论 *Critic. Rev. Food Sci. Nutri.* (2021)。 <https://doi.org/10.1080/10408398.2021.1946673>

主要研究内容:对沙棘及其他北欧浆果在天然食品防腐剂原料生产中的应用潜力进行了综述。

7. Markkinen N, Laaksonen O, Yang B, 与 *Lactobacillus Plantarum* 影响发酵及其对沙棘汁挥发性成分的研究。欧洲食品研究 *Eur. Food Res. Technol.* (2021), DOI: 10.1007/s00217-020-03660-3

主要研究内容:研究了苹果酸乳酸发酵工艺对其组成和性能的影响以及沙棘汁的感官特性。

paper, the impact of Malolactic fermentation on volatile aroma compounds of sea buckthorn juice was studied.

本文介绍了苹果乳酸的影响并且对沙棘汁挥发性香气成分的发酵进行了研究。



TYRNIRAKI Project

关于 TYRNIRAKI 项目

2.1 TYRNIRAKI project received funding

TYRNIRAKI 项目资金资助

The Turku University Foundation granted funding to the TYRNIRAKI. A short-term researcher has been employed for the project in 2021. The soil samples were analysed in terms of physical properties and microbial composition. A manuscript is being prepared based on the results.

图尔库大学基金会为 TYRNIRAKI 提供了资金。2021 年，项目雇佣了一个短期研究人员。对土壤样品进行了物理特性分析和微生物组成分析。一份基于研究结果的论文正在准备中。

BIESKKE DUORDNAGIEDDI

Turku ammattilainen Elintarvikekemian ja elintarvikekehityksen osastolla ja Osoo-rikanta gä löysä duordnagieddi

Vuorokuvon 8.6.2021 gäiväpöytäsi-
soorvintokuvassa a vasa. Osoogakuvot

Marja Bieskka - Bieska marja - kuvallista ja
biednämälöidöä.

Ohjojaga artikla: Bieskka gä ja tyhjä ja
vakuutus



Maailman pohjoisin tyrniviljelmä ja tutkimuskoeala Karigasniemellä

Viljelmä n tausta ja tarkoitus
Viljelmä perustettiin kesä kussa 2 0 2 1
Alustus "Tytit", "Tehä" - ja "Tähti" - lajikkeilla
Sekä tuotanto- että tutkimusmailla (Hilppopohä rhamnoides L.)
Viljelmä n altaus Niila Pieskin
Tutkimuksesta vastaa Turun yliopisto (Elintarvikekemian ja elintarvikekehityksen
yksikkö ja Lapin tutkimuslaitos Keve)
Selvitetään n pokolisuuden vaikutusta tyrnin laatuun ja menestymismahdollisuuksiin

Mitä tutkimuksissa on aiemmin selvinnyt?
Tyrni voi menestyä Lapissa kunhan lajikkeet ja menetelmät ovat kohdallaan
Marja kypsyy vielä kasvukauden pää tyttyä
Marja sä llyy syö mä helpoosena penssaassa pidempää n kuin Etelä-Suomessa
Satoa voidaan korjata myös pakkaamalla
Tyrnin koostumusta on selvitetty laajasti ja monipuolisesti
Utjoella ei ole aiemmin koettu tyrninviljelyä - riskiprojekti

Lapin tyrnimarjoissa:

- Enemmän n C vitamiinia (verrattuna Etelä-Suomeen) (1)
- Enemmän sokereita (1)
- Enemmän fenolia yhdistelmiä (flavonoglykosidit ja proantocyanidit) (1, 2)
- Öljyä enemmän linolihappoa ("sä itä mä n" rasvahappo) (3)
- Enemmän n kvebraktoia (tyrnin sokerikalokoli) (1)
- Kasvukauden lämpö tta ja valo vaikuttavat koostumukseen (1, 2)
- Marjat voidaan erottaa muualla kasvanneista NMR-analyyseillä (4)

Tyrnimarjan syö nti (ihmiset):

- Alentaa tyhjälisänsuoa (CNP) (5)
- Alentaa aterian jälkeistä insuliinitasoa (fenoliset yhdisteet vaikuttavat) (6)
- Ilmeisesti alentaa sydän- ja verisuonitautien riskiä (mehu) (7)

Tyrnimarjan syö nti (eläimet):

- Tyrnin kvebraktili tasaa diabeettokohilien sokeri- ja insuliinitasopainoa (8)

Tyrniöllyn syö nti (ihmiset):

- Vähentää verhiutaleiden saakautumista (9)
- Lievittää a atopian oireita ja vaikuttaa veriglasman rasvahappoihin (10)
- Lievittää a kuvaavimä syyden oireita ja muuttaa hyyntelen koostumusta (11)
- Parantaa a tyrnin 2 diabeettisen riskin (12)
- Edistää a tyrnin flavonoidien imeytymistä (13)
- Edistää a intiniälueen limakalvojen terveyttä (14)

Tyrniöllyn syö nti (eläimet)

- Enhättäessä isoä ja parantaa rotan mahan haavoumia (15)
- Suojaa rotan maksaa ja DNA:ta hapatumiselta (in vitro) (16)



Kuva: Photoplan

**Kirjallisuusviitteet [TY: n
elintarvikekemian yksikön julkaisuja]:**

(1) J. Agric. Food Chem. 2018, 66 (24), 5044-5048
(2) Food Chem. 2017, 216, 87-95
(3) Food Res. Int. 2015, 77, 108-119
(4) Food Chem. 2014, 147, 188-195
(5) Res. J. Chem. Nat. 2008, 02, 1123-1129
(6) Res. J. Chem. Nat. 2010, 04, 1465-1473
(7) J. Nat. Studies. 2009, 02, 244-254
(8) J. Pharm. Pharm. 2013, 16, 223-231
(9) J. Nat. Studies. 2010, 02, 463-468
(10) J. Nat. Studies. 1999, 10, 622-630
(11) J. Nat. 2010, 10, 1482-1488
(12) Res. J. Chem. Nat. 2010, 04, 1284-1292
(13) J. Agric. Food Chem. 2006, 04, 7364-7368
(14) Molecules. 2018, 23, 310-321
(15) Molecules. 2010, 21, 644-650
(16) Food Res. Int. 2011, 42, 2009-2017

2.2 Sea buckthorn plantation in Utsjoki

A plantation was established by University of Turku in Utsjoki, Finland in 2021. The plantation has now about 300 sea buckthorn bushes, which is the most northern sea buckthorn plantation in the world. The plantation will be used for studying the impact of subarctic latitude on the composition and physiology of sea buckthorn. The establishment of the plantation is supported by the Turku University Foundation and the University of Turku.

乌茨约基的沙棘种植园

2021年，图尔库大学在芬兰乌茨约基建立了一个种植园(这是世界上纬度最高的沙棘种植园)。种植园现在大约种植有300株沙棘，这个人工沙棘林将用于研究亚北极纬度对沙棘的组成及生理特性的影响。种植园由图尔库大学和图尔库大学基金会的支持下建立。





Some pictures taken from the sea buckthorn planting event on the shore of the Teno River, Utsijoki, Finland (06–08.06.2021, Photos of Baoru Yang' s album).
一些拍摄于芬兰乌茨约基 Utsijoki 天诺 Teno River 河岸的沙棘种植活动照片，
(2021 年 6 月 8 日，杨宝茹)。





Sea buckthorn plantations to reduce phosphorus leakage into the Finnish Archipelago Sea via the outlet-rivers (TYRNIRAKI project)

沙棘种植减少磷通过出口河泄漏到芬兰群岛海项目 (TYRNIRAKI)

A ten-year sea buckthorn project, “TYRNIRAKI”, organized by the University of Turku has started in South-West Finland to reduce leakage of phosphorus, nitrogen and other nutrients from the farmed fields into the local rivers. The Archipelago Sea suffers from severe eutrophication, and annual “cyanobacterial blooming” is not anymore only a visual problem. The increased rainfalls and shorter snow-covered winters, evidently due to the climate change, worsens the situation. The TYRNIRAKI project lead by the Food Chemistry and Food Development unit of the University of Turku aims to utilize sea buckthorn stands in nutrient sequestration in the Finnish Archipelago Sea drainage basins. The effects of the sea buckthorn stands to the nutrient cycles are monitored by studying the composition and the quality of the soil and the biomass produced, as well as the soil microbiome. In 2020, over 3,000 sea buckthorn saplings were planted in five different river bank areas in the southwestern Finland.

由图尔库大学组织的一个为期十年的沙棘项目“TYRNIRAKI”已经在芬兰西南部启动，以减少磷、氮和其他营养物质从农田流入当地河流的情况。群岛海遭受着严重的富营养化，每年“蓝藻繁盛”不再仅仅是一个视觉问题。明显由气候变化引起的降雨增加和冬季降雪缩短使情况更加恶化。由图尔库大学食品化学和食品发展单位领导的 TYRNIRAKI 项目的目的是利用沙棘在芬兰群岛海流域的营养捕获。通过对沙棘林分组成、质量、生物量和微生物群的研究，监测沙棘林分对土壤养分循环的影响。2020年，在芬兰西南部的5个不同河岸地区种植了3000多棵沙棘树苗。

3.1 The Finnish Archipelago Sea

The Finnish Archipelago Sea is one of the most valuable natural resources in the Nordic countries. The sea with its 40 000 islands and islets started to be formed only 10 000 years ago after the local icecap melted towards the end of the ice age. This inland sea is shallow, the salt content is low and the connection to the Atlantic Ocean is very narrow. This is why the nutrient leakages cause an immediate problem and we have to reduce the local runoffs from our farmed fields in the rivers and further into the sea. The whole ecosystem

芬兰群岛海

芬兰群岛海是北欧国家最宝贵的自然资源之一。海洋和它的40000个岛屿和小岛开始形成于10000年前，当地冰冠在冰河时代末期融化了。这片内海较浅，含盐量较低，与大西洋的连接非常狭窄。这就是导致养分泄漏的原因，这是一个迫在眉睫的问题，我们必须减少当地从农田流入河流的径流深入大海。整个生态系统受损，导致生活条件越来越差。我们需要几个选项来解决这个问题，“TYRNIRAKI”

suffers and our living conditions are getting worse. We need several options to resolve the problem and the “TYRNIRAKI” project is one of them. (TYRNIRAKI; tyrniä ravinteiden kierrätykseen, sea buckthorn to harvest nutrients)

3.2 The action plan

The first sea buckthorn (SB) seedlings were planted in May 2020 in five riverbed and seashore fields in SW-Finland. The four SB varieties were all of Finnish origin. Ten-year agreements with the farmers guarantee the proper management of the bushes that are at disposal of the University of Turku for research and follow-up. The sea buckthorn fields bind nutrients and carbon, and the soil quality is improved and the biodiversity increases. Neither fertilizers nor herbicides/pesticides are used on the test fields. The leakages in the local rivers and into the sea decrease, and P and N are removed by harvesting and by the field treatments. (Figure 1.)

This brings along additional business opportunities for the farmers and the goal is to multiply the SB plantations according to the upcoming results. (Figures 2 and 3.)

3.3 The functional model from China

The Ministry of Water Resources (China) has over 30 years of experience on the topic. The International Seabuckthorn Association (ISA, SCISA), run by the Ministry, is an international organization, and the University of Turku has joined the activities since 1989.

Sea buckthorn seedlings have been planted in wide areas, e.g. at the Huang He River Plateau to bind soil, to produce berries and to make the

项目就是其中之一。(TYRNIRAKI; Tyrniö ravinteiden kierrätykseen, 沙棘收获养分)

具体行动计划

第一批沙棘幼苗于 2020 年 5 月在芬兰西南部的 5 个河床和海滨地区种植。四种沙棘品种都来自芬兰。与农民签订的 10 年协议保证对图尔库大学用于研究和后续工作的沙棘林进行适当管理。沙棘林地固定了养分和碳，改善了土壤质量，增加了生物多样性。试验林地既不使用化肥，也不使用除草剂/杀虫剂。当地河流和海洋的排污量减少，磷和氮通过收集和田间处理被清除。(见图 1)。

这为农民带来了额外的商业机会，目标是根据即将到来的研究结果扩大沙棘种植园。(见图 2 和 3。)

学习来自中国的有效模式

中国水利部在这方面有 30 多年的经验。由水利部管理的国际沙棘协会(理事会 ISA/技术委员会 SCISA)是一个国际组织，图尔库大学自 1989 年以来加入了该活动。

沙棘已广泛种植在中国黄河流域的黄土高原地区，用于固土、生产果实和绿化造林。不管在中国还是在芬兰，沙棘均是一个重要的和不断

reforestation possible. SB is a significant and increasing line of business, as well in China as in Finland. Among the plants tested, SB is the best one to bind soil and to reduce erosion caused by water, wind and frost. As a heritage from this long-term co-operation, the University of Turku has a wide knowledge of SB as well, with more than 100 scientific international publications.

增长的产业。在已经试验的植物中，沙棘是保持水土，减少因水蚀、风蚀和冻融造成水土流失的最好植物。作为这一长期合作的遗产，图尔库大学也拥有广泛的合成生物学知识，拥有100多份国际科学出版物。

3.4 A plan for the entire country

The aim is to multiply the concept but it requires changes in the domestic farming regulations, especially related to the shelter zones. Further, significant financial and political support from the government is necessary. It is a long-term project and results faster than in 10 years should not be expected. The farmers have taken a positive attitude. Multidisciplinary co-operation in natural sciences, technology, nutrition, agricultural sciences, also with entrepreneurs and industry is a must. Removal of phosphorus from the fields is more effective than from the sea.

整个芬兰的国家计划

其目的是扩大推广这一理念，但它需要改变国内的农业法规，特别是与保护区有关的法规。此外，来自政府的重大财政和政治支持是必要的。这是一个长期项目，不应指望10年内就能取得成果。农民们采取了积极的态度。在自然科学、技术、营养、农业科学以及企业家和工业领域的多学科合作是必须的。从林地里去除磷比从海里除磷更有效。



Figure 1.
图 1 项目思路

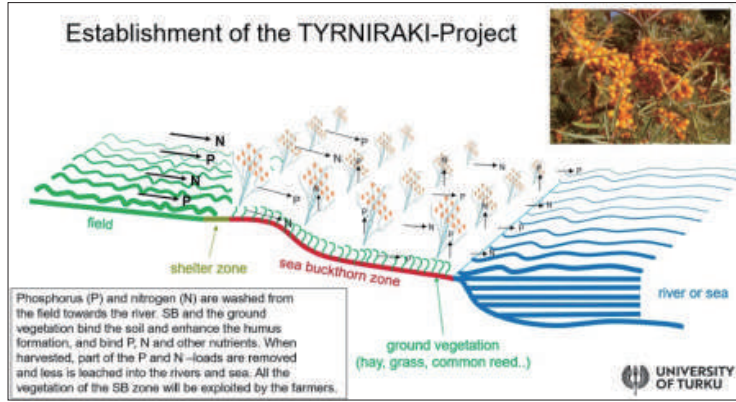


Figure 2
图 2 项目构造

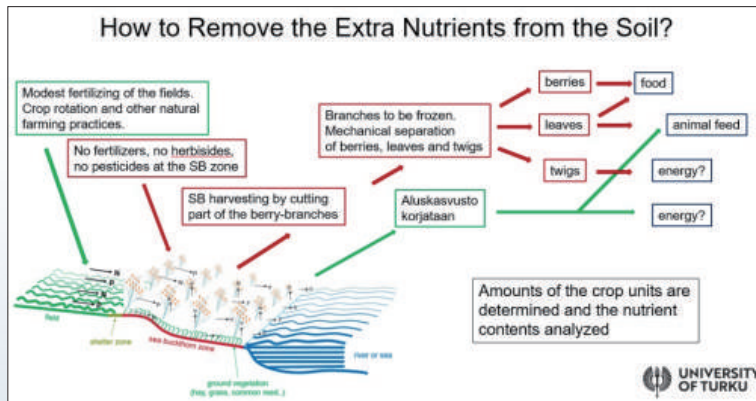


Figure 3.
图 3 如何去除土壤中多余营养



Cultivation and processing

沙棘种植和加工

In 2021 in Finland there were 160 grower and they had total area 60 ha in such stage that it was possible to get crop. The total crop was 24 tons. The hectares in cultivation were remarkable less than in 2020 and also crop was lower (30 tons in 2020). There are no analysis which caused the drop.

In addition to growers there are many small home growers with some bushes and these are not included in statistics. In the coastal area of Finland there are wild sea buckthorn bushes and people have right to pick berries. Also this crop is not included in statistics.

In Finland the biggest volumes in sea buckthorn products are juices and beverages. Because cultivation is so small, berries and juice are mainly imported. About 500 tons of frozen berries were imported.

Also in Finland there is special production of products based on sea buckthorn. These are sea buckthorn oils produced by supercritical fluid extraction process by Aromtech Ltd. Use of sea buckthorn material is thousands of tons calculated as weight of fresh berries. Products are food supplements and products for different symptoms.

Aromtech Ltd has continued co-operation with vocational college on Lapland to boost sea buckthorn cultivation in Northern part of Finland . The way is to combine education and pilot cultivation. Aromtech has invested on sea buckthorn bushes. Students of the college can get experience of cultivation, crops, handle and sales

2021年，芬兰有160名种植者，可产果面积为60公顷，总产量为24吨。与2020年相比，种植面积显著减少，总产量也更低(2020年为30吨)。目前还没有分析是什么原因造成的。

除了种植园主，还有许多小型的家庭沙棘种植者，他们种植的沙棘不包括在统计数据中。在芬兰的沿海地区有野生的沙棘林，当地居民有权利采摘天然沙棘浆果。此外，这些天然沙棘也不包括在上述统计中。

在芬兰，最主要的沙棘产品是果汁和饮料。因为芬兰的沙棘种植面积很小，沙棘浆果和果汁主要依靠进口。每年大约进口500吨冷冻浆果。

芬兰也有以沙棘为基础的特色产品，包括Aromtech有限公司采用超临界流体萃取工艺生产的沙棘油。每年加工利用数千吨的沙棘鲜果原料，加工的产品是针对不同症状的食品补充剂和产品。

Aromtech公司继续与拉普兰的职业学院合作，促进芬兰北部沙棘的种植。途径是教育与试点种植栽培相结合，由Aromtech投资沙棘种植，

of crops before starting their own cultivation on their home fields. This experimental phase will take several years and results will be informed. In 2021 the first berries were picked for different analysis and scientific purposes.

该学院的学生在自己开始果园种植之前，可以先学到沙棘种植、采收、处理和销售果实的经验。这个实验阶段将持续数年时间，有关结果以后将会公布。在 2021 年，采收了第一批沙棘浆果，用于不同的分析和科学目的。



The sea buckthorn farm of Reijo Koivu (Photo: Baoru Yang, 21.08.2021)
 位于 Reijo Koivu 的沙棘农场 (图片来源 : 杨宝茹 , 21.08.2021)

3. Country Report of France



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The Experience of Seabuckthorn Development of France in 2021

2021 年法国沙棘开发的经验

In France, SBT is called Argousier. According to the research, there is not a significant evolution of commercial plantation seabuckthorn (SBT) in France. But evolution of fresh fruit demand, and live plant market for meadow gardens is obvious. And it is this, that will help, through fresh fruit consumption in meadow gardens, according to data, to popularize seabuckthorn in France. Here is a quick resumé of the positive experience with seabuckthorn in 2021.

沙棘在法国称作 Argousier。研究表明，沙棘商业种植在法国并没有得到明显的进展。但鲜果需求和草甸花园活植物市场的演变是明显的。数据显示，通过对草地花园中食用新鲜水果需求，有助于在法国推广沙棘。以下是关于 2021 年在法国沙棘积极体验。



Growth of seabuckthorn market and plantation in France

法国的沙棘市场增长和种植园



German variety of SBT Hergo in center of region Bretagne
引种在法国 Bretagne 地区的德国沙棘品种 Hergo

The increase of SBT market in France this year is mostly concentrated on nurseries.

Sales of seabuckthorn plants has increased, with overall fruit plants market over the past year. Meadow garden with SBT as a nitrogen fixing plant is where it has found most popularity.

There has been growing German sort Hergo in center of region Bretagne with oceanic climate. Testing plot there with this sort, is where it has grown most, from 68 cm in early August of 2020 to 375 cm measured in June of 2022.

There is a significant presence of spontaneous wild SBT in Baie de somme region Picardie. There in the silex stones of the bay, that extends over 70 km facing sea, are kilometers of bushes of seabuckthorn. In The upper schorre environment, where SBT can be found there is presence of halophyte vegetation, such as *Plantago maritima*, *Elymus hystrix*, *Artemisia vulgaris*, *Triglochin maritima*. Also photos from a trip to find large wild spontaneous populations of SBT on north coast next to Belgium.

This year we have taken our first trip there, to observe these large populations of wild SBT that can sometimes be quite productive, in comparasion to other wild spontaneous SBT that we were able to observe in nature. Here on the photograph some berries are to be ripen in late August, and some were quite mature and ready to be harvested.

In 2021, 75% of households bought at least one plant at a stable rate compared to 2020. This represents 21.3 million households. At the individual level, more than half of French people aged 18 and over have made at least one purchase of plants during the year (+2 pts vs 2020).

The average household budget increased sharply and amounted to €130 (+€17.20 vs 2020), the average

今年法国沙棘市场的增长主要集中在苗圃。沙棘植物的销售有所增加，在过去的一年里，整个水果植物市场销量都在增长。沙棘作为固氮植物在草甸花园中是最受欢迎的。

在具有海洋气候的布列塔尼 Bretagne 中心地区，引种了来自德国的沙棘优良品种：黑哥 Hergo。这一品种在试验地中生长最快，从 2020 年 8 月初的 68 厘米增长到 2022 年 8 月的 375 厘米。

在 Picardie 地区的索姆海湾同样分布许多天然沙棘。海湾砾石遍布，在 70 公里长的海湾，沙棘灌木林绵延数公里。与沙棘相伴的还有 *Plantago maritima*, *Elymus hystrix*, *Artemisia vulgaris*, *Triglochin maritima* 等植物种类。靠近比利时的法国北海岸，我们也发现大面积野生沙棘自然种群。

2021 年，我们对本地大面积沙棘林进行了第一次野外考察，其结实状况良好，一般在 8 月末沙棘果实成熟，一些已经充分成熟，即可采收。

与 2020 年相比，2021 年 75% 的家庭至少购买了一株植物，购买率稳定。这代表了法国 2130 万家庭。在个人层面，超过一半的 18 岁及以上的法国人在一年内至少购买过一次植物（与 2020 年相比增加 2%）。

平均家庭预算大幅增加，达到 130 欧元（与 2020 年相比增加 17.20 欧元），平均采购数量



法国西北部索姆河湾

quantities purchased returned to a level similar to before the crisis, thus going from 29.7 to 31.7 plants.

恢复到危机前的水平，因此从 29.7 株增加到 31.7 株。

The market benefited from a boom in value with a sharp increase in the sums spent by 15% driven by outdoor and indoor plants, but in volume the finding is more mixed (+5%). Outdoor plants still constitute the bulk of the volumes, and their weight is increasing in value. The growth of the market in value is mainly linked to the increase in the average amount spent on a plant, observed at all places of purchase.

该市场受益于价值的增涨，户外和室内植物的支出大幅增加了 15%，但在数量上，发现则更为复杂（增长 5%）。室外植物仍然构成了体积的大部分，它们的价值正在增加。市场价值的增长主要与平均花费在单株植物的金额的增加有关，这在所有的购买场所都可以观察到。

Garden centres, markets and DIY and decoration stores are experiencing a sharp increase in volumes to the detriment of mass distribution, which is losing market share. In terms of sums spent, all places of purchase are progressing (apart from mail order) and exceed pre-crisis levels, especially garden centers which are gaining market share.

Internet purchases, which were a potential growth lever in 2020, will stabilize in 2021: the rate of Internet buyers is 6% for indoor plants and 6% for outdoor plants (8% overall for ornamental plants outside the vegetable garden, as in 2020).

园艺中心、市场以及 DIY 和装饰商店的数量急剧增加，不利于大规模分销，后者正在失去市场份额。就花费金额而言，所有的购买场所都在进步（除了邮购），超过了危机前的水平，尤其是花园中心的市场份额正在增加。

互联网购买是 2020 年潜在的增长杠杆，将在 2021 年稳定下来：室内植物和室外植物的互联网买家比例分别为 6% 和 6%（与 2020 年一样，植物园外观赏植物的互联网买家比例为 8%）。



Gain of popularity of Seabuckthorn, as a nitrogen fixing plant

沙棘作为固氮植物的普及推广

Seabuckthorn has gain popularity in France, mostly in meadow gardens for its strong ability to fix nitrogen in soil. For this use, the plants has been more and more recognized, but less for taste of berries which is left to debate, and more for it's bacterial symbiosis. Therefore there has been a slight increase of use of seabuckthorn in France, but mostly has a companion plant in gardens. It is sold more and more for such purpose and with this popularity of fruits should increase.

But market for juices, compotes, purees as well as dried fruits is much less dynamic in France, than fresh fruits and furthermore organic certified fruits. Therefore the increase of seabuckthorn plantation at small scale and with various sorts of SBT, in various regions may benefit more to the polarity of the fruit.

Most of the fruit consumed in France is fresh fruit: between 76% and 85% depending on the

沙棘在法国受欢迎主要是在草甸花园应用中，因为它有很强的固定土壤中氮的能力。由于这种用途，这种植物已经被越来越多的人所认识，但很少是为了浆果的味道，这是一个争论，更多的是因为它的细菌共生关系。因此，沙棘在法国的应用略有增加，但大多在花园中有一种伴生植物。为了这个目的，它的销量越来越多，沙棘浆果受欢迎程度应该会增加。

但在法国，果汁、蜜饯、果泥以及干果的市场远没有新鲜水果和有机认证水果那么活跃。因此，在不同地区增加种植小规模、不同类型的沙棘品种，有助于扩大沙棘的知名度。

法国农业综合公司 (France AgriMer) 的数据显示，法国消费的大部分水果都是新鲜水果：

month of the year, according to France AgriMer. Juices, compotes and purees as well as dried fruits therefore remain in the minority. The most consumed fruit in France is the apple with an average of 16 kilos swallowed per year and per household. Then come the banana (12 kilos), the orange (10 kilos) and the clementine (8 kilos). Thus, according to Crédoc, the percentage of households buying organic fruit and vegetables increased from 42% to 51% between 2007 and 2010.

Therefore it is believe SBT will see its popularity increase in the coming years, as a meadow garden plant with nitrogen fixing capacities. Commercial plantation of SBT has not significantly increased, and remain quite confidential, around 10 hectares. Meadow garden plantation will remain for a while the principal vector of familiarizing with SBT, as nitrogen-fixing. It is this way, through familiarizing with the plant, that the consumers will look for it in the stores.

To conclude, Bacterial symbiosis of SBT with amongst other, bacteria frankia, is what is mostly looked after. It is what will motivates gardeners to plant SBT. Increase in sales of plants, suggested by nurseries for such purpose is the most significant market for SBT in France.

根据月份的不同，新鲜水果的消费比例在 76% 至 85% 之间。因此，果汁、蜜饯、果泥以及干果仍然是少数。在法国，消费最多的水果是苹果，每个家庭平均每年消费 16 公斤。然后是香蕉 12 公斤，橙子 10 公斤和小柑橘 8 公斤。根据 Crédoc 统计，法国家庭购买有机水果和蔬菜的比例从 2007 年的 42% 上升到 2010 年的 51%。

因此，我们相信沙棘作为一种具有固氮能力的草甸花园植物，在未来几年将会越来越受欢迎。沙棘的商业种植没有显著增加，保守估计大约 10 公顷。在一段时间内，草甸花园人工林仍将是应用沙棘作为固氮植物的主要领域。正是为此目的，消费者将在商店中购买沙棘。

综上所述，沙棘 frankia 细菌的共生关系是最受关注的。这将激励园艺工作者种植沙棘。苗圃植物销售的增长显示，固氮特性是法国沙棘销售市场最重要的因素。



Trying to ferment Seabuckthorn nodule in simple solution of dextrose and water

在葡萄糖和水的简单溶液中发酵沙棘根瘤实验

For this simple experiment, I have tried to infuse SBT nodules in various amounts, previously hashed and dried in a simple solution of sugar and water. The idea was to leave the solution ferment for a period of time and try to extract some of the bacterial life that would grow. Inspiration of such simple test came from the observation and personal culture of red tea mushroom or SCOBY.

为了这个简单的实验，我试着往捣碎和干燥沙棘根瘤中注入不同数量的糖和水的简单溶液中。研究想法是让溶液发酵一段时间，然后试着提取一些可以生长的细菌。这一实验灵感来自对红茶的观察和个人培养的红茶菇（SCOBY 红茶菌）。

In fact, some deposit showing presence of bacterial activity in the bottom of the liquid culture, and in the upper part of the recipient, Reminded somehow of the red tea mushroom or SCOBY (Symbiotic culture of bacteria and yeast) called Komubtcha sometimes.

Some interesting studies seem to show that this bacteria and yeast symbiosis, could act as filter to some contaminants in water.

事实上，在液体培养物的底部和受体的上部，一些沉积物显示了细菌的活性，不禁让人想起了红茶菇或SCOBY(细菌和酵母的共生培养)，有时被称为“康普茶”Komubtcha。一些有趣的研究似乎表明，这种细菌和酵母菌的共生，可以作为水中一些污染物的过滤器。



Composition of red tea mushroom

红茶菇的成分

Source: wikipedia :

Kombucha is made from the fermentation of black tea or green tea and sugar by a symbiosis of yeasts and bacteria, that takes the form of a disk forming above the culture during fermentation.

The culture used in making tea varies and consists of different species of yeast and bacteria. The acetic acid bacteria that can be found are, among others, *Acetobacter aceti subsp. aceti*, *Gluconobacter oxydans subsp. industria*, *subsp. oxydans* and *Gluconoacetobacter xylinus*.

The yeasts that can be found are, among others, *Saccharomyces ludwigii*, *Schizosaccharomyces pombe*, *Brettanomyces bruxellensis*, *Pichia fermentans*, *Candida stellata*, *Torulaspora delbrueckii* or *Zygosaccharomyces bailii*. Other bacteria of the genus *Bacterium* are present: *Bacterium xylinum*, *Bacterium gluconicum*, *Bacterium xylinoides*, *Bacterium katogenum*.

根据“维基百科”，康普茶 Komubtcha 是由发酵红茶或绿茶和糖而产生的，酵母和细菌的共生，在发酵过程中形成一个圆盘的培养物。

用于制茶的培养物各不相同，康普茶由不同种类的酵母和细菌组成。其中可以发现醋酸细菌，此外还有醋酸杆菌亚种 *Acetobacter aceti subsp. Aceti*，氧葡萄糖酸杆菌亚种的工业种群 *Gluconobacter oxydans subsp. industria*，氧杆菌 *subsp. oxydans* 和木糖醋杆菌 *d Gluconoacetobacter xylinus*。

所发现的酵母菌包括：路德酵母密码子 *Saccharomyces ludwigii*，饱满分裂糖酵母菌 *Schizosaccharomyces pombe*，布鲁氏布雷特酵母 *Brettanomyces bruxellensis*，发酵毕赤酵母 *Pichia fermentans*，星状念珠菌 *Candida stellata*，布鲁氏圆孢酵母 *Torulaspora delbrueckii* 或贝利接合酵母菌

Thus, depending on the method of preparation, Kombucha may have a varied composition, and in particular contaminants such as molds or fungi, which may cause adverse effects if ingested.

On analysis, the solution is usually acidic and contains traces of alcohol, ethyl acetate, acetic acid and lactates. It would also contain gluconic acid, lactic acid, amino acids, antibiotic compounds, folic acid and enzymes. The carbon dioxide released by the fermentation gives this drink a light fizziness.

Yeasts transform sugar into alcohol, bacteria alcohol into acids: each producing organic substances that benefit the other symbiont. Acidifying the solution prevents unwanted bacteria, yeasts and molds from growing. The structure of the "mother" is composed of cellulose produced by some of the bacteria, and there is also chitin from the cell wall of yeasts.

Zygosaccharomyces bailii。其他细菌属的细菌：木细菌 *Bacterium xylinum*，葡萄球菌 *Bacterium gluconicum*，木酸杆菌 *Bacterium xylinoides*，加原菌 *Bacterium katogenum*。

因此，根据制备方法的不同，康普茶可能含有不同的成分，特别是霉菌或真菌等污染物，如果摄入可能会造成不良影响。

经分析，溶液通常是酸性的，含有微量的酒精、乙酸乙酯、乙酸和乳酸。还含有葡萄糖酸、乳酸、氨基酸、抗生素化合物、叶酸和酶。发酵过程中释放的二氧化碳使这种饮料有一种轻微的气泡。

酵母将糖转化为酒精，细菌将酒精转化为酸：每一种都会产生有益于其他共生体的有机物质。酸化溶液可以防止有害细菌、酵母和霉菌的生长。“母体”的结构由一些细菌产生的纤维素组成，也有来自酵母细胞壁的甲壳素。



Similitudes with nodule of seabuckthorn as fermented in water and dextrose or sugar cane molasses

类似于沙棘的根瘤，在水和葡萄糖或甘蔗糖蜜中发酵

When fermenting root nodosity from seabuckthorn, there are similitude and slight differences with the culture of red tea mushroom. In both case presence of lactic bacteria creates a distinct smell, some chitin also seems to be produced in the SBT tea of root nodosity. This approach is empirical and need a series of more scientific test to push forward the composition of nodosity fermented as such.

沙棘根瘤发酵与红茶菇培养有相似之处，但有细微差异。在这两种情况下，乳酸菌的存在产生了一种独特的气味，一些甲壳素似乎也产生在沙棘茶的根瘤。这种方法是有经验的，需要一系列更科学的试验来推动这样发酵的根瘤组成。



Testing the fermentation in Citrus culture and mushroom substrate

柑橘培养物和蘑菇底物的发酵试验

Tea from fermented root nodules is also given to citrus, diluted in nutritive solution and seems to have an overall benefit for them. Similar test were done with giving SCOBBY to citrus, with positive results, and I believe SBT nodosity tea may act positively on citrus health.

Oyster mushrooms is probably one of the easiest mushroom to grow, but mold contamination is always an issue. Including the tea of fermented nodosity in growing substrates seems to reduce such contamination. But further tests need to be produced, and a mushroom lab will be implanted in our home.

Again this is for now more an empirical approach since more test should be done and species of bacteria that are able to grow in liquid culture of nodosity tea are not yet identified.

发酵根瘤产生的茶也可以用于柑橘，稀释营养溶液似乎对柑橘有全面的好处。用上述红茶菌 SCOBBY 对柑橘进行了类似的实验，得到了好的结果，含根瘤的沙棘茶可能对柑橘健康有积极作用。

平菇可能是最容易栽培的蘑菇之一，但霉菌污染总是一个问题。在生长基质中加入发酵根瘤茶似乎可以减少这种污染。但还需要进一步的实验，为此我家中将建一个蘑菇实验室。

目前这更多的是一种经验方法，因为需要做更多的实验，而且能够在根瘤茶液体培养中生长的细菌种类还没有确定。





Significative Presence of spontaneous wild SBT in region Picardie
分布在法国西北部索姆湾 Picardie 地区的海滨沙棘天然林



Significative Presence of spontaneous wild SBT in region Picardie
分布在法国西北部索姆湾 Picardie 的海滨沙棘天然林



Male one of wild SBT in region Picardie
天然海滨沙棘雄株树势健壮



野生海滨沙棘果实累累 Photograph were taken in 17 / 08 / 2021



野生海滨沙棘果实 Photograph were taken in 17 / 08 / 2021



野生海滨沙棘果实 Photograph were taken in 17 / 08 / 2021



Culture of red tea mushroom or SCOBY 培养红茶菌



To ferment Seabuckthorn nodule 培养根瘤菌试验

4. Country Report of India



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Annual Report on Seabuckthorn of India for 2021

2021 年印度沙棘发展报告



Research and Development in CSK Himachal Pradesh Agricultural University, Palampur 132001, HP

印度 CSK 喜马偕尔邦农业大学沙棘研究与开发

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1.1 Improvement of seabuckthorn germplasm bank and mother orchards

The potential local selection and exotic form of seabuckthorn are being maintained in the mother orchards at High Land Agriculture Research and Extension Centre (HAREC) at Kukumseri, in Lahaul. These genotypes belong to *Hippophae rhamnoides* and *H. salicifolia*. These plants are being used for mass multiplication. The work on improvement of the mother orchard of existing seabuckthorn at HAREC Kukumseri has been initiated and new mother orchards of the high yielding Russian varieties will be planted in March 2022 to meet the demand of planting materials of improved varieties/selection of seabuckthorn in future. Germplasm bank was strengthened by introducing seeds of ten varieties of seabuckthorn from Russia, Latvia and Belarus during 2013-14 through NBPGR. These varieties are under testing at HAREC Kukumseri (Fig. 1).

1.1 沙棘种质资源库和母树园改良

从当地选育和外国引进沙棘优良类型现保存在 Lahaul 的 Kukumseri 高原农业科研推广中心的母树园中, 其基因类型属于鼠李沙棘和柳叶沙棘, 这些沙棘植株正用于大规模扩繁。对 Kukumseri 高原农业科研推广中心已有沙棘母树园的改进工作已经启动, 来自俄罗斯的高产沙棘品种将于 2022 年 3 月定植在母树园中, 以便满足将来种植优良沙棘品种的需要。通过 2013-2014 年间引进 10 个来自俄罗斯、拉脱维亚和白俄罗斯的沙棘品种, 种质资源库得到加强。目前这些品种在 Kukumseri 高原农业科研推广中心进行引种试验(见表 1 和图 1)。

Table 1: Details of Exotic varieties imported by CSKHPKV Palampur
 表 1 喜马拉雅尔农业大学从外国引进沙棘品种介绍

Sr. No. 编号	Accession No. 附编号	Source country 种源国	Source Institution 品种培育单位
1.	NX-1	Russia 俄罗斯	Institute of Cytology & Genetics SD, RAS Str. Lavrentyeva 10, Novosibirsk-630090, RUSSIA 俄罗斯农科院细胞遗传研究所
2.	NX-4	Russia 俄罗斯	-do-
3.	NX-5	Russia 俄罗斯	do-
4.	NX-2	Russia 俄罗斯	do-
5.	NX-3	Russia 俄罗斯	do-
6.	NX-10	Russia 俄罗斯	Northern Research Institute of Forestry, Nikitov St., 13 Arkhangelsk 163062 (Russia) 俄罗斯北方林业研究所
7.	NX-11	Russia 俄罗斯	-do-
8.	NX-6	Latvia 俄罗斯	-do-
9.	NX-7	Latvia 拉脱维亚	Latvia State Institute of Fruit Growing, Graudu Str. 1, Dobele LV-3701, LATVIA 拉脱维亚国家果树栽培研究所
10	NX-8	Belarus 白俄罗斯	Central Botanical Garden of Academy of Sciences, 2 A Surganov Street, Minsk, Belarus 220012 (Belarus) 白俄罗斯科学院中央植物园



Fig. 1. Newly established Sea buckthorn mother orchard of Exotic varieties
 图 1 新建引进沙棘品种母树园

Production of planting materials –Local seabuckthorn selection “Drilbu” (*H. salicifolia*), a unique seabuckthorn genotype in Himalaya, selected from Tinu village, Lahaul, and two exotic form of seabuckthorn i.e. HI-2 from Russia, (*H. rhamnoides* spp. *mongolica*) and NX-12 an exotic form from Ukrain origin imported from Russia have been selected for mass multiplication. During last year, 5000 plants of Russian seabuckthorn were produced and during this year target is to propagate 25000 plants of these improved selections.

苗木生产。Drilbu 品种是从 Lahaul 的 Tinu 村选育、具有喜马拉雅山地区珍贵的柳叶沙棘基因的当地优良沙棘材料，连同从俄罗斯引进的 2 个外国品种 HI-2 和 NX-12 (蒙古沙棘亚种基因型)已经大量繁殖。去年扩繁了 5000 株，今年计划繁殖 25000 株。

1.2 Demonstration on cultivation of seabuckthorn

Four thousand rooted plants of three seabuckthorn cultivars, *H. salicifolia* (Drilbu) the local selection, HI-2 from Russia, (*H. rhamnoides* spp. *mongolica*) and NX-12 an exotic form from Ukrain have been provided to farmers for demonstration on cultivation of seabuckthorn in collaboration with forest department in Lahaul (Fig. 2).

沙棘栽培示范

与 Lahaul 林业部门合作，3 个品种 (Drilbu 品种以及俄罗斯引进的 2 个外国品种 HI-2 和 NX-12)、4000 株带根苗木提供给当地村民进行沙棘栽培示范。(见图 2)

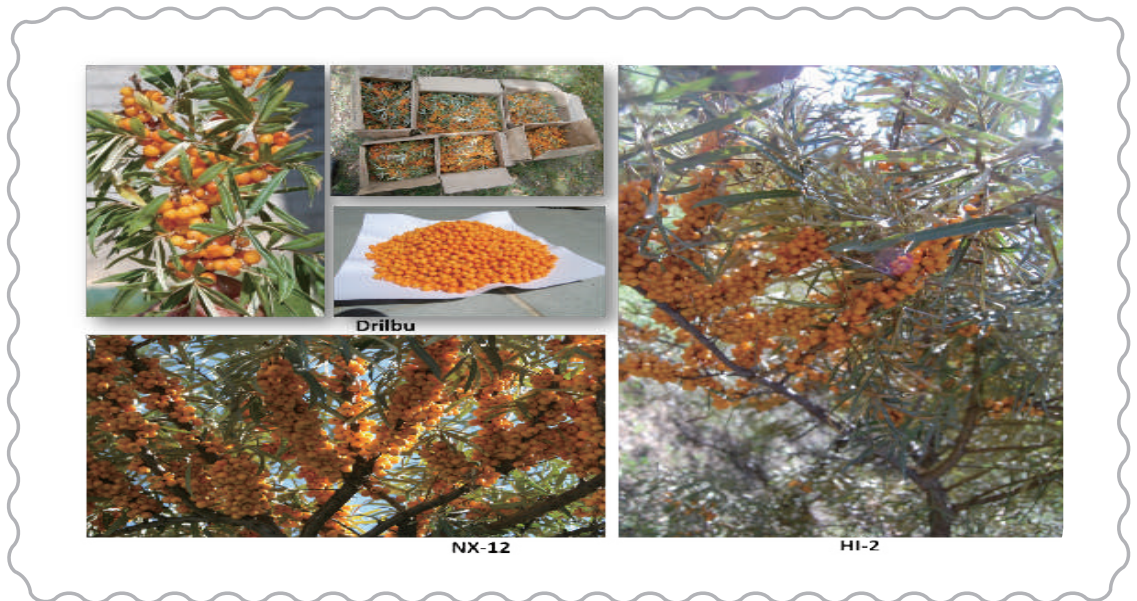






Fig. 2. Multiplication of planting materials
图 2 扩繁种植材料

1.3 Nutrient dynamics in relation to maturation of Berries

To study the nutrient dynamics in relation to maturation of fruits, the berries were collected three times during its maturation to access the best time for harvesting of different varieties/ selection of seabuckthorn. Sample collection of berries was done between 20th September to 10th October. First collection was done 20th September (I), second on 29th September (II) and third on 10th October (III).

与沙棘果实成熟相关的营养机理研究

为研究沙棘果实成熟相关的营养机理研究，在成熟过程中分三次采样，以便评估不同沙棘品种的最佳采果期。9月20日、9月29日和10月10日分别第一次、第二次和第三次采样。

a. Oil content in Berries: It was observed that the oil contents in fresh fruits of different seabuckthorn cultivars varied significantly with the time of harvesting and the cultivar. Two years data revealed that the maximum oil content (3.03%) was found in local selection Darcha, followed by 2.29% in NX-12 during the second harvesting and the least during 3rd harvesting in all selection. However the maximum oil content was observed in NX-12 and Dirlbu cultivars during second harvesting. Overall, exotics HI-2 and NX-12 have lesser contents of oil than the local cultivar “Darcha”.

果实中油含量分析。分析发现，沙棘鲜果实中油的含量随着品种不同和采样期呈现显著变化。两年的观测数据显示，当地选育品种 Darcha 含有率最高，为 3.03%；其次是引进品种 NX-12，9 月 29 日采样时为 2.29%；10 月 10 日采样时，所有品种的含油率最低。然而，品种 NX-12 和 Dirlbu 在第二次采样（9 月 29 日）时含油率最高。总体看，外国引进品种 HI-2 和 NX-12 的含油率低于当地品种 Darcha。

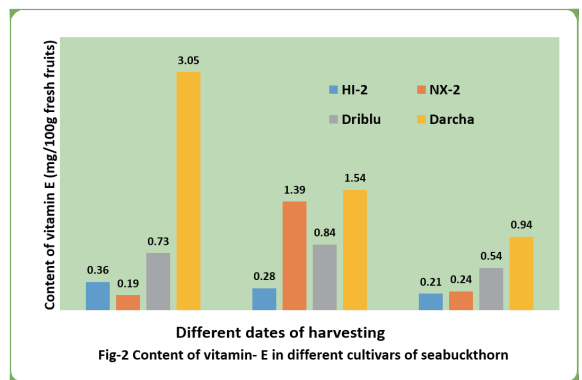
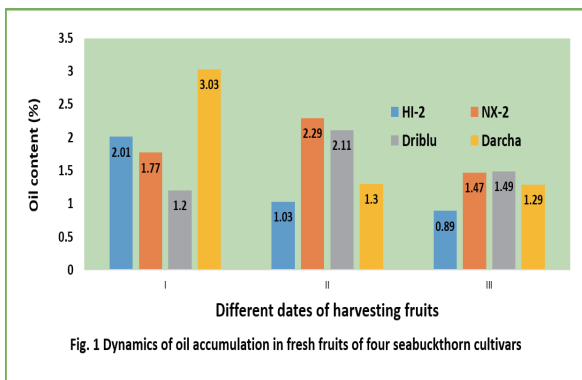
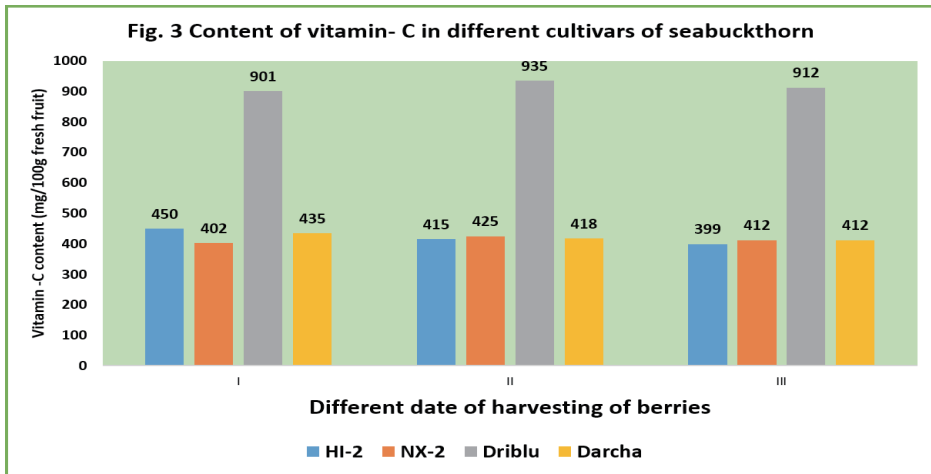


图 3：不同沙棘品种维生素含量对比

b. Vitamin E & Vitamin C:-Vitamin E contents in fresh fruits of different seabuckthorn cultivars varied from a minimum of 0.2 mg/100g to 4.0 mg/100g during the different harvesting dates the maximum Vitamin E content was observed in local selection i.e. Darcha during all the harvesting dates followed by NX-12 during 2nd harvesting. However, the vitamin C content was found maximum in Drillbu cultivar during all the harvesting dates (Fig. 3).

It has been observed that the maximum content of oil, Vitamin E and Vitamin C was during 1st harvesting in cultivar HI-2 and Darcha which were reduced as the harvesting was delayed. So these cultivars have to be harvested by 20th September. However, NX-2 and Drillbu cultivars showed maximum nutrient dynamics during 2nd harvesting date which means the harvesting can be done in the last week of September to 1st week of October.

1.4 Development of Entrepreneurship

A women Self Help Group Khandorma is being strengthened by providing planting materials of improved selections of seabuckthorn varieties and technical support in collaboration with the Department of Forest Lahaul under the project SECURE Himalaya (GOI-UNDP-GEF) project in Lahaul Pangti. CSKHPKV Palampur is providing technical support under MIDH Project on Seabuckthorn Establishment of Research and Training Centre to the Women Self Help Group Khandorma of Tingrit Panchayat. SHG has established small processing unit at Tingrit with the financial support from Department of Forest Lahaul. They are producing various products.

1.5 Industries

Four seabuckthorn based industries, namely, Chd Agrotech, Baddi, Shiva Agroprocessors,

维生素 E、C 分析。不同沙棘品种鲜果的 VE 含量在不同采样期的变动于 0.2 mg/100g – 4.0 mg/100g。其中，当地选育品种 Darcha 在三次采样期的 VE 含量均最高，其次是 9 月 29 日采收的 NX-12 品种。当地品种 Drillbu 在三次采样期的 VC 含量最高。（见图 3）

观测发现，品种 HI-2 和 Darcha 在第一次采样时（9 月 20 日）VE、VC 含量最高，随后逐渐下降。因此，这两个品种应在 9 月 20 日前采收。品种 NX-2 和 Drillbu 在第二次采样时营养成分最高，所以其采收期应该在 9 月的最后一周到 10 月的第一周。

企业开发

与 Lahaul 林业局合作，通过在 Lahaul Pangti 实施的 SECURE Himalaya (GOI-UNDP-GEF) 项目，提供沙棘良种苗木和技术支持，妇女自助组织 Khandorma 的能力得到加强。设在 Palampur 的 CSKHPKV 通过 MIDH 项目建立沙棘研究培训中心，为 Tingrit Panchayat 妇女自助组织 SHG 提供技术帮助。在 Lahaul 林业局的资金支持下，妇女自助组织 SHG 已经在 Tingrit 建立一个小型加工厂，生产一系列沙棘制品。

产业发展

当地已建成 4 座沙棘加工企业：位于 Baddi 的 Chd Agrotech 公司、位于 Sundernagar

Sundernagar, Zeon, Pauntasahib and Minch, Soghi have come up on seabuckthorn. They are processing various seabuckthorn health products, exporting to global and Indian markets. These companies are marketing seabuckthorn juice, jam, tea and oil etc.

的 Shiva Agroprocessors 公司、地处 Pauntasahib 的 Zeon 公司和地处 Soghi 的 Minch 公司。上述公司加工沙棘果汁、果酱、茶、油等系列保健产品，销往印度国内外市场。



Seabuckthorn Leaves– Phytochemical analysis, antioxidant activity, and toxicity evaluation

沙棘叶的植物化学分析、抗氧化活性和毒性评价

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2.1 Introduction

Sea buckthorn (*Hippophae rhamnoides*) is a plant found throughout Europe and in certain parts of Asia. In India Seabuckthorn is found in Himalayas and trans Himalayas. Almost all parts of Seabuckthorn have been found to have medicinal properties. The leaves, flowers, seeds, and fruits are frequently used in various preparations for health benefits. Seabuckthorn leaves are rich in vitamins A, B1, B2, B6, and C, as well as other active ingredients. Traditionally, Seabuckthorn is used for treatment of burns, wounds, eczema, acne, indigestion, high blood pressure, wrinkled skin, and many other purposes. The plant material grown in wild should always be subjected to certain basic tests for recommending for human use. A number of DRDO laboratories have been engaged in developing various health products from Seabuckthorn. Development of a radiation countermeasure for human use has been one

引言

沙棘广泛分布在欧洲和亚洲部分地区。在印度，沙棘分布横贯喜马拉雅山区。沙棘全身都具有药用价值沙棘叶、花、果实、种子常用于人体健康的不同配方。沙棘叶富含维生素 A、B1、B2、B6、C 和其他活性成分。传统上，沙棘用于治疗烧伤、创伤、湿疹、痤疮、消化不良、高血压、皮肤褶皱等。长期以来，野生沙棘一直是服务人类的基本功能实验材料。国防研究中心的几个实验室已经在从事沙棘系列保健品开发。人体抗辐射研究一直是一个挑战性工作，从沙棘叶中提取的一种特殊成分显示出辐射保护特性，可以查到许多相关文献资料。沙棘的多样性得到充分研究。据报道，沙棘根瘤菌产

the challenging task. A particular extract of Seabuckthorn leaves has already been shown to have radio-protective properties and large number of publications are already available for such an information. The diversity of Seabuckthorn has been well studied, Seabuckthorn rhizobacteria have been reported to produce ACC deaminase and exhibit PGPR traits (Bala et al., 2015, 2017, Singh et al, 2020, Bhadreacha et al, 2018).

Seabuckthorn leaves were collected from remote location of Leh, Laddakh and were processed. Their phytochemical analysis, antioxidant activity and toxicity evaluation in small animals was conducted, before their onwards utilisation in health products for human use. A brief of the activities is presented as below:

2.2 Estimation of phytochemicals from Seabuckthorn leaf

- Gallic acid, gallic acid ethyl ester and quercetin have been quantified in aqueous and methanolic extracts of Seabuckthorn leaf powder by HPTLC Method.
- Gallic acid (7-8 mg/g) was extracted in aqueous solvent, whereas Gallic acid ethyl ester (4.5-5.5 mg/g) and Quercetin (3-4 mg/g) were extracted in methanolic solvents from leaf powder of Seabuckthorn.
- The quantitative analysis of phytochemicals such as total content of carbohydrate, proteins, phenolics, ascorbic acid, flavonoids, tannins and fiber of aqueous leaf extract of Seabuckthorn were carried out.
- Total content of phytochemicals such total carbohydrate (32-36%), total proteins (0.5-1.5%), total phenolics (1.5-2.4 g/100g), ascorbic acid (301-319 mg/100g), flavonoids (0.08-0.15), total tannins contents (8-9 g/100g) and total fiber contents (8.5-10.5 %) were recorded in Seabuckthorn leaf extract.
- Free Radical Scavenging Activity (FRSA)

生 ACC 脱氨基酶而具有 PGPR 特性 (Bala 等, 2015, 2017; Singh 等, 2020; Bhadreacha 等, 2018)。

从拉达克列城的偏远地区收集沙棘叶并进行前处理后, 对样品进行植物化学成分分析, 以及动物抗氧化活性和毒性评估, 然后再将它们用于人类健康产品。以下是其活性简介。

沙棘叶植物化学物质的评价

- 利用 HPTLC 方法检测沙棘叶片粉末的水和甲醇提取物中的没食子酸、没食子酸乙酯和槲皮素含量。
- 水提溶剂中的没食子酸含量 7-8 mg/g, 甲醇提取剂中的没食子酸乙酯含量 4.5-5.5 mg/g, 槲皮素含量 3-4 mg/g。
- 对植物化学成分 (如碳水化合物、蛋白质、酚类、抗坏血酸、黄酮类、单宁和纤维) 进行定量分析。
- 沙棘叶提取物种含有总碳水化合物 (32-36%)、总蛋白质 (0.5-1.5%)、总酚类 (1.5-2.4 g/100g)、抗坏血酸 (301-319 mg/100g)、类黄酮 (0.08-0.15)、总单宁含量 (8-9 g/100g) 和总纤维含量 (8.5-10.5 %)。
- 基于 DPPH 方法的沙棘叶提取物自由基

or antioxidant activity of leaf extract of Seabuckthorn by DPPH method

- Aqueous leaf extract of Seabuckthorn was exhibited very good antioxidant (96.25 at 150 µg) property in the DPPH method. Hence, IC50 value (84.9 µg/ml) of seabuckthorn leaf extract was recorded. Low IC50 value= High potent antioxidant property.

清除活性 (FRSA) 或抗氧化活性。

- 沙棘叶的水提物表现出非常好的抗氧化性 (96.25 at 150µg)。因此，沙棘叶提取物的 IC50 值为 84.9 µg/ml，低 IC50 值 = 强效抗氧化性能。

2.3 Toxicity evaluation of aqueous extract of Seabuckthorn leaf

沙棘叶水提物的毒性评价

Acute toxicity:

Aqueous extract of Seabuckthorn was administered at different doses viz 30, 125, 500 and 2000 mg/kg body weight orally to different groups of female rats. The acute toxicity study was carried out according to the OECD Guideline (423) and animals were observed for 14 d for any toxic symptoms.

- No mortality and signs of toxicity were observed in any animals during the observation period.
- Oral LD50 of aqueous extract of SB Leaf powder was not found up to 2g/kg body weight of rat.

急性毒性:

沙棘水提物以不同剂量给药，即对不同组的雌性大鼠口服 30、125、500 和 2000 mg/kg 体重。根据经合组织 OCED 指南 (423) 进行急性毒性研究，观察动物 14 天的任何毒性症状。

- 在观察期间，未发现动物死亡和毒性迹象。
- 口服 LD50 沙棘叶粉水提物的大鼠体重未上涨 2g/kg。

Sub-acute toxicity:

Sub-acute toxicity of aqueous extract of Seabuckthorn leaf has also carried out in female rats as per OECD guideline No. 407. The Aqueous extract of Seabuckthorn was orally administered to animals for 28 days at dose 2 g/kg body wt.

- The aqueous extract of Seabuckthorn leaf given to animals by oral route did not show any signs of toxicity and mortality as observed by no changes in organ weight, body weight, food intake, and serological and hematological parameters.
- It is found safe and non-toxic at dose of 2 g/kg body wt.

亚急性毒性:

根据 OECD 指南第 407 号，沙棘叶水提物的亚急性毒性也在雌性大鼠中进行，沙棘水提取物以 2 g/kg 体重的剂量对动物口服给药 28 天。

- 沙棘叶水提物经口服给药后，动物的器官重量、体重、摄食量、血清学和血液学参数均无变化，未显示出任何毒性和死亡迹象。
- 在 2g/kg 体重的剂量下是安全无毒的。



Combination of Seabuckthorn Phenolics and *L. rhamnosus* GG Activates Anti-inflammatory Pathways in Chemically Induced Colitis

沙棘酚和鼠李糖杆菌 GG 联合激活化学诱导结肠炎的抗炎通路

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Dietary polyphenols and probiotic bacteria are two of the most potential bioactive components known to influence human health. The interaction of probiotic strains and polyphenols appears to have an additive or synergistic effect on host health. Amalgamation of polyphenols with probiotic bacteria, with synergistic benefits of both bioactive components can be considered as a promising approach in the management of a number of gastrointestinal diseases. The scientific rationale of the present work was based on the two-way interaction between probiotics and dietary polyphenols.

The aim was to develop two probiotic-fortified, fruit based (sea buckthorn and apple) functional beverages that would effectively provide protection against intestinal inflammation, especially Inflammatory bowel disease (IBD).

The effects of two fruit matrices, malt supplemented apple juice (APJ+M) and malt supplemented sea buckthorn juice (SBT+M), on the protective and in vivo anti-inflammatory effect of *Lactocaseibacillus rhamnosus* GG (LR) against intestinal inflammation using DSS- induced colitis models were

食用多酚和益生菌是已知影响人类健康的两种最具潜力的生物活性成分。益生菌菌株和多酚的相互作用似乎对宿主健康具有累加或协同作用。多酚与益生菌的结合, 显示出 2 种生物活性成分的协同作用, 其被认为是治疗多种胃肠疾病的一种有前途的方法。本研究的科学依据是基于益生菌和膳食多酚之间的双向相互作用。

本研究目的是开发两种益生菌强化水果(沙棘和苹果)功能性饮料, 可有效防止肠道炎症, 尤其是炎症性肠病 (IBD)。

使用 DSS 诱导的结肠炎模型, 添加麦芽苹果汁 (APJ+M) 和添加麦芽沙棘汁 (SBT+M), 两种水果模型对鼠李糖乳杆菌 GG (LR) 对肠道炎症的保护和体内抗炎作用的影响在斑马鱼 (*Danio rerio*) 中进行了研究。在斑马鱼模型中评估了 APJ+M+LR 和 SBT+M+LR 以及

investigated in zebrafish (*Danio rerio*). The protective effect of APJ+M+LR and SBT+M+LR, as well as APJ+M, SBT+M, and LR separately against chemically induced intestinal inflammation was assessed in zebra fish model. Fishes were fed with the standard fish pellets coated with the experimental beverages twice a day for 30 days. For DSS induced experimental colitis, fishes were exposed to 1% DSS dissolved in tank water for 3 days. The intestinal tissues were sampled for further assessment. Administration of the test beverages attenuated several effects of DSS-induced colitis, including disrupted intestinal barrier integrity, impaired tissue anti-oxidant status and expression of colitis associated pro-inflammatory markers. The results reveal that the effectiveness of each treatment group in modulating barrier function and gut immunity was varied.

Probiotic fortified Sea buckthorn juice (SBT+M+LR) had a greater protective effect than the probiotic fortified apple juice (APJ+M+LR) against mucosal damage, as demonstrated by a reduction in histopathological score (Fig 4). SBT+M+LR exhibited remarkable anti-oxidant properties by increasing the activity of the CAT, SOD, GPx, and GSH antioxidant enzymes, which were impaired due to DSS administration. Inflammatory mediators (NF- κ B, TNF- α , IL-1 β , IL-6, IL-8, CCL20, MPO and MMP9) as well as anti-inflammatory cytokine (IL-10) were measured in colonic tissue. Administration of the test beverages resulted in a decrease of NF- κ B, TNF- α , IL-1 β , IL-6, IL-8, CCL20, MPO and MMP9 and an increase of IL-10 expression. The greater protective impact of SBT+M+LR compared to APJ+M+LR shows that Sea buckthorn (SBT) phenolics play a supporting role in improving the immunomodulatory activities of LR in vivo.

Overall, the study shows that combining probiotics with polyphenols have synergistic effects and may help to alleviate immunological dysfunction and protect against colitis, suggesting potential alternative therapy for IBD.

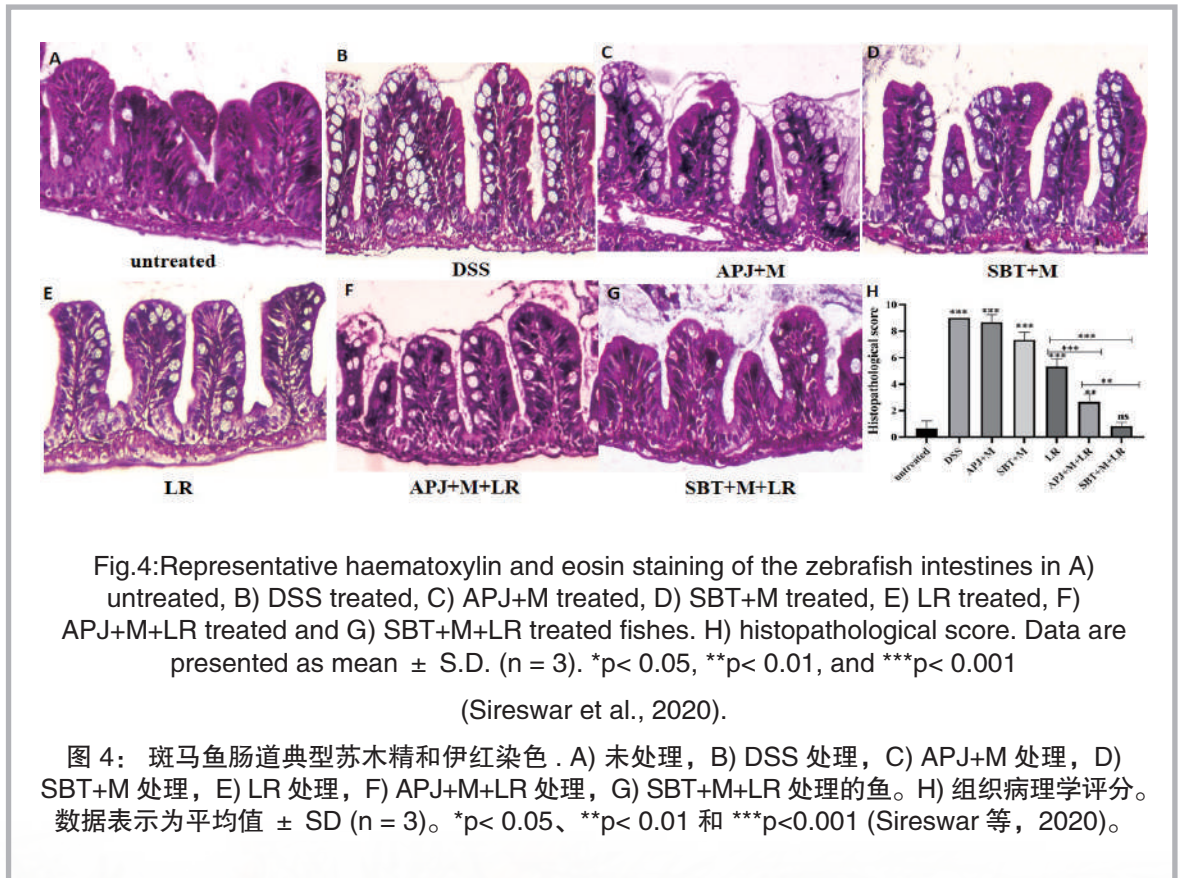
APJ+M、SBT+M 和 LR 分别对化学诱导的肠道炎症的保护作用。每天两次用涂有实验饮料的标准鱼丸喂养鱼，持续 30 天。对于 DSS 诱导的实验性结肠炎，将鱼暴露于溶解 1% DSS 的鱼缸水中 3 天。对肠组织进行取样进行评估。测试饮料的施用减弱了 DSS 诱导结肠炎的影响，包括破坏肠道屏障完整性、受损组织抗氧化状态和结肠炎相关促炎标志物的表达。结果表明，每个治疗组在调节屏障功能和肠道免疫方面的有效性各不相同。

组织病理学评分降低表明，益生菌强化沙棘汁 (SBT+M+LR) 比益生菌强化苹果汁 (APJ+M+LR) 对黏膜损伤的保护作用更大 (见图 4)。SBT+M+LR 表现出明显的抗氧化活性，其得益于 CAT、SOD、GPx、和 GSH 抗氧化酶的高活性，其受 DSS 给药而受损。在结肠组织中检测炎症介质 (NF- κ B、TNF- α 、IL-1 β 、IL-6、IL-8、CCL20、MPO 和 MMP9) 以及抗炎细胞因子 (IL10)。试验饮料的给药导致 NF- κ B、TNF- α 、IL-1 β 、IL-6、IL-8、CCL20、MPO 和 MMP9 减少和 IL-10 表达的增加。与 APJ+M+LR 相比，SBT+M+LR 的保护作用更大，这表明沙棘酚类物质在提高 LR 体内免疫调节活性方面发挥了辅助作用。

总体而言，该研究表明，将益生菌与多酚结合具有协同作用，可能有助于缓解免疫功能障碍和预防结肠炎，即是 IBD 的潜在替代疗法。

In this study, seabuckthorn phenolics demonstrated higher degree of anti-inflammatory properties than apple phenolics (Fig 5). This knowledge could aid in development of therapeutic functional food products to address inflammation-related disorders in humans, such as IBD.

在这项研究中，沙棘酚类物质比苹果酚类物质表现出更高的抗炎特性（见图 5）。这些发现可以帮助开发治疗性功能食品，以解决人类炎症相关疾病，例如 IBD。



Latest list of publications related to studies on seabuckthorn

1. Sireswar, S., Dey, G., & Biswas, S. (2021). Influence of fruit-based beverages on efficacy of *Lactobacillus rhamnosus* GG (*Lactobacillus rhamnosus* GG) against DSS-induced intestinal inflammation. *Food Research International*, 149, 110661. <https://doi.org/10.1016/j.foodres.2021.110661>.
2. Sireswar, S., Biswas, S., & Dey, G. (2020). Adhesion and anti-inflammatory potential of *Lactobacillus rhamnosus* GG in a sea buckthorn-based beverage matrix. *Food & Function*, 11(3), 2555-2572.
3. Sireswar, S., & Dey, G. (2019). Matrix-wise evaluation of *in vivo* and *in vitro* efficiencies of *L. rhamnosus* GG-fortified beverages. *Food Research International*, 119, 908-919.
4. Sireswar, S., Ghosh, I., Dey, K., Behera, L., Reza, M., Das, S. S., & Dey, G. (2019). Evaluation of probiotic-beverage matrix interaction for efficient control of *Enterobacter aerogenes* and *Staphylococcus aureus*. *Journal of Food Protection*, 82(4), 669-676.
5. Sireswar, S., Montet, D., & Dey, G. (2018). Principal Component Analysis for clustering probiotic-fortified beverage matrices efficient in elimination of *Shigella* sp. *Fermentation*, 4(2), 34.
6. Sireswar, S., Dey, G., Sreesoundarya, T. K., & Sarkar, D. (2017). Design of probiotic-fortified food matrices influence their antipathogenic potential. *Food Bioscience*, 20, 28-35.

近期发表的沙棘相关论文、专著 (中文略)

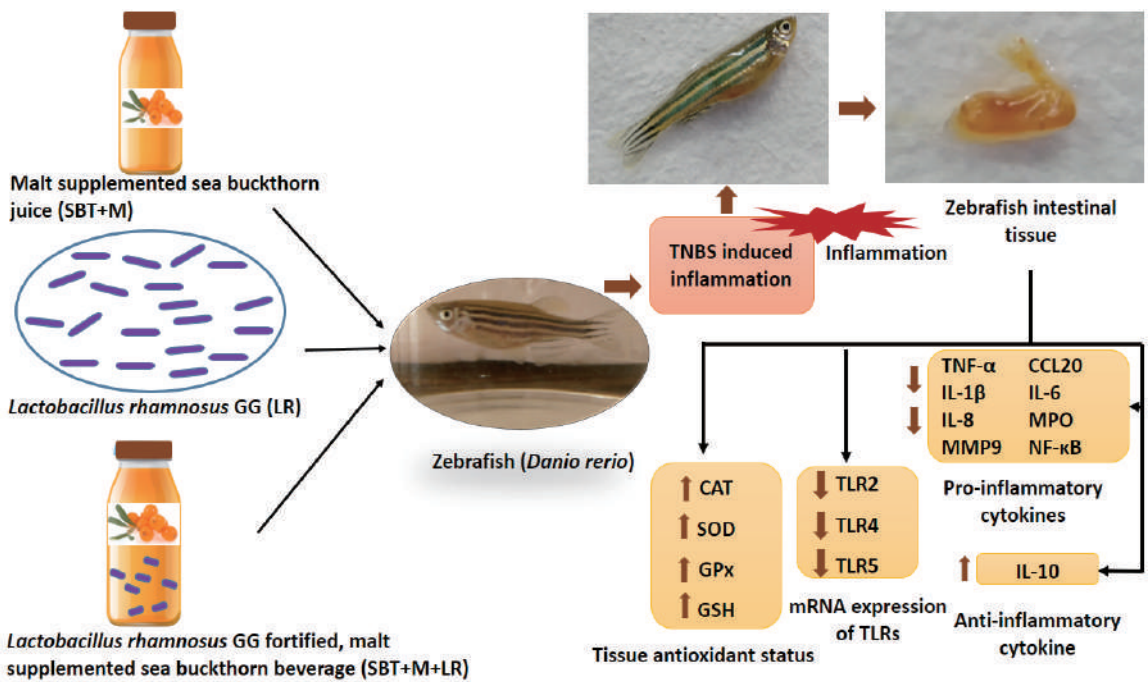


Fig 5. Enhanced anti-inflammatory potential of seabuckthorn phenolics with probiotics *L. rhamnosus*

图 5 沙棘酚类与鼠李糖益生菌的增强抗炎潜力



Deciphering the Proteome and Biotechnological Potential of a Himalayan Wonder Plant – Seabuckthorn

破译喜马拉雅神奇植物沙棘的蛋白质组和生物技术潜力

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Seabuckthorn (Hippophae), is a stress hardy Himalayan shrub well-adapted to extreme environmental conditions prevalent at higher altitudes. Still, a very little is known about its stress tolerance mechanism where the information is restricted to the laboratory grown seedling. Our group is trying to explore the diverse stress hardiness mechanism of naturally growing Indian seabuckthorn populations using proteomics as a tool.

Recently, a proteome data set (4870 proteins) generated using the comparative shotgun (nano LC-MS/MS) proteomics approach is the worldwide first comprehensive protein repository of *H. rhamnoides*, *H. tibetana* (Trans-Himalayan) and *H. salicifolia* (Sikkim) seabuckthorn populations. The dataset is submitted in PRIDE 'PROteomicsIDentifications database' proteomics data repository with accession number "PXD023184".

Interestingly, the proteomic resilience highlighted the underlying physiological adaptive mechanisms in higher and lower altitude seabuckthorn populations. The findings showed a clear trade-off between growth and stress induced proteome plasticity where *H. rhamnoides* and *H. tibetana*

沙棘 (Hippophae) 是喜马拉雅地区一种抗逆强的灌木, 能够很好地适应高海拔地区普遍存在的极端环境条件。尽管如此, 人们对其胁迫耐受机制知之甚少, 所知信息仅限于实验室种植的幼苗。我们团队正试图以蛋白质组学为工具, 探索自然生长的印度沙棘种群的多种抗逆机制。

最近, 使用“比较鸟枪法”(nano LC-MS/MS) 蛋白质组学方法, 获得了 4870 种蛋白质组数据。这是世界上第一个鼠李沙棘、西藏沙棘(横贯喜马拉雅地区)和柳叶沙棘(锡金)种群蛋白质库。原始数据已提交到 PRIDE 'PROteomicsIDentifications 数据库' 中, 编号为“PXD023184”。

有趣的是, 蛋白质组弹性突显了高海拔和低海拔沙棘种群的潜在生理适应机制。研究结果表明, 在生长和应激诱导的蛋白质组可塑性之间

populations repress their growth and divert energy resources in the direction of better stress responses (with redox signaling and response to stimulus) to survive harsher alpine conditions.

On the contrary, in *H. salicifolia* growing at lower altitude invest in resource allocation or growth-promoting pathways (cellular, metabolic and biological regulation of physiological processes) to survive the milder stress conditions in sub-alpine environment. Interestingly, this is the first comprehensive proteome analysis to dissect the altitudinal gradient associated stress acclimation strategies in different naturally growing Indian seabuckthorn populations.

Besides, seabuckthorn being freeze-tolerant shrub, capable of withstanding temperatures below -40°C has also been deciphered for cold/freeze modulated proteome and antifreeze proteins (AFPs) in laboratory grown seabuckthorn seedlings. The proteo-map is available on world 2D-PAGE repository. AFPs are ice binding proteins which prevents the freezing associated damages by restricting ice crystals growth in a non-colligative manner.

Our group has optimized the techniques for detection of antifreeze activity using Phase contrast microscopy coupled with Nanoliter osmometer where hexagon shaped ice crystals confirmed the presence of AFPs in seabuckthorn. Additionally, ice-affinity chromatography have been optimized for homogenous purification of AFPs from *H. rhamnoides* seedling (Polygalacturonase inhibitor protein, 41 kDa), leaf (low temperature induced protein, 41 kDa) and berry (disease resistance protein, 41 kDa). Likewise, dual functioning chitinases possessing both hydrolytic and antifreeze activity have also been purified using chitin affinity chromatography.

存在明显的权衡, 其中鼠李沙棘和西藏沙棘种群抑制其生长并将能量资源转向更好的应激反应 (氧化还原信号传导和对刺激的反应), 以在更恶劣的高山条件下生存。

相反, 在低海拔生长的柳叶沙棘更倾向于资源分配或生长促进途径 (细胞、代谢和生物调节的生理过程), 以在亚高山环境下的一般逆境下生存。有趣的是, 这是第一次综合的蛋白质组分析, 剖析了在不同生长环境下的印度沙棘种群中海拔梯度与胁迫适应的关系。

此外, 沙棘是抗寒灌木, 能够承受低于 -40°C 的温度, 我们也已在实验室种植的沙棘幼苗中破译出寒冷 / 冰冻调节的蛋白质组和抗冻蛋白 (AFPs)。通过全 2D-PAGE 绘制蛋白谱图。AFPs 是冰结合蛋白, 它通过以非依附方式限制冰晶生长来防止与冷冻相关的损害。

我们团队优化了使用相差显微镜和纳升渗透压计检测抗冻活性的技术, 其中六边形冰晶体证实了沙棘中存在 AFPs。此外, 冰亲和层析已从沙棘幼苗 (聚半乳糖醛酸酶抑制剂蛋白, 41 kDa)、叶 (低温诱导蛋白, 41 kDa) 和浆果 (抗病蛋白, 41 kDa) 中均质纯化 AFPs。同样, 已使用几丁质亲和色谱法纯化了具有水解和抗冻活性的双功能几丁质酶。

This probably is the first report of antifreeze proteins purification from naturally growing seabuckthorn. These purified seabuckthorn AFPs were also explored for the biotechnological application. The preliminary finding showed ability of AFPs to enhance the survival of cryopreserved rat RBCs by providing protection against freeze-thaw induced hemolysis. Efforts to scale up purification by over expression are currently underway.

In addition to the above findings, gold nanoparticles (AuNPs) have been synthesized from *H. rhamnoides* leaf and berry. It is interesting to note that these AuNPs allowed efficient remediation of dye contaminated waste-water into non-toxic byproducts having industrial applications (Fig. 6).

这可能是第一次从自然生长的沙棘中纯化抗冻蛋白的报道。这些纯化的沙棘 AFPs 也可用于其他生物技术应用。初步发现表明，AFP 能够通过防止冻融引起的溶血来提高冷冻保存的大鼠红细胞的存活率。目前正在努力通过过度表达来扩大纯化规模。

除了上述发现之外，还从鼠李沙棘叶和浆果中合成了金纳米粒子 (AuNPs)。有趣的是，这些金纳米粒子可以有效地将染料废水修复为具有工业应用的无毒副产物 (见图 6)。

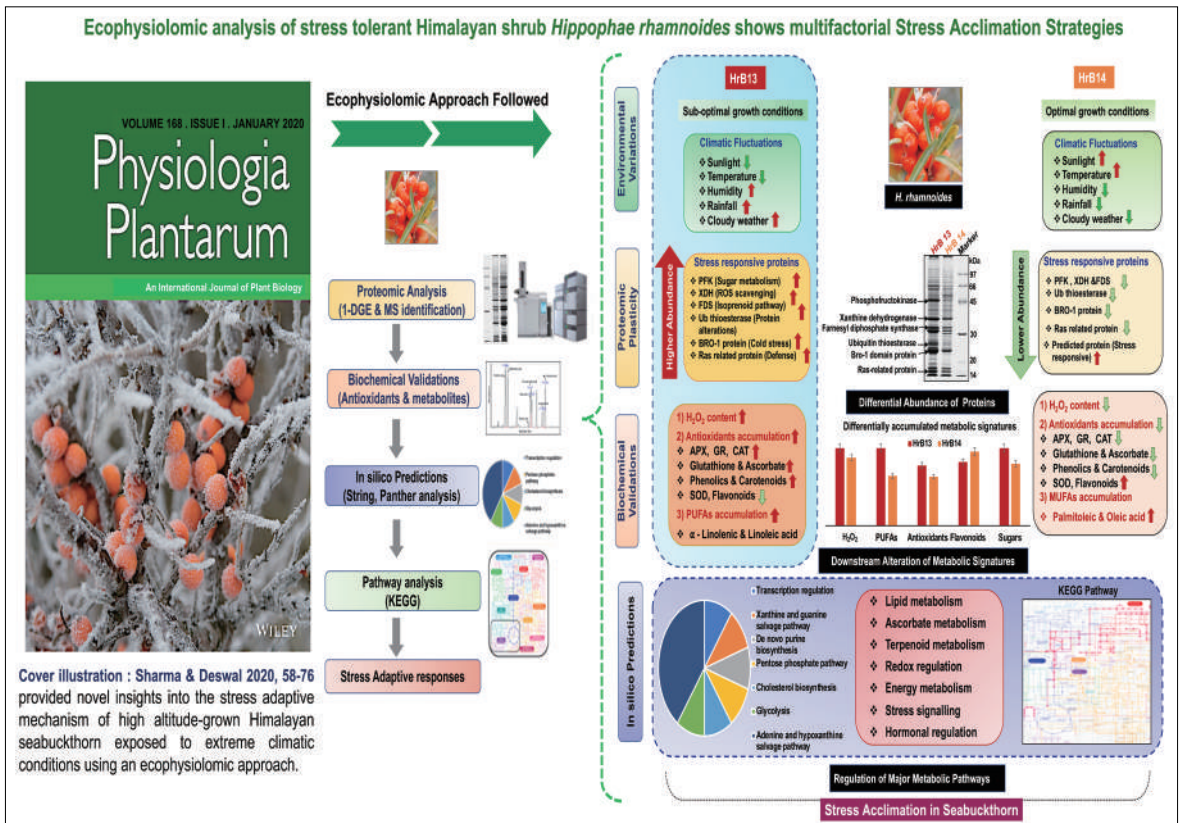


Fig.6 (图6) 喜马拉雅抗性植物沙棘的生态生理分析显示其多因素胁迫适应策略



R&D in University School of Biotechnology, Guru Gobind Singh Indraprastha University, Sector 16C, Dwarka, New Delhi- 110078
Guru Gobind Singh Indraprastha 大学的沙棘研究开发情况

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Our laboratory has been working on seabuckthorn in diverse areas. We have recently focused on:

- Metabolome diversity in seabuckthorn collection from Himachal Pradesh, Union Territory of Ladakh and Arunachal Pradesh region of Indian Himalayas.
- Comparative analysis of antioxidant properties of leaf and berry extract of selected *H. rhamnoides* and *H. salicifolia* collections.
- Cytotoxic evaluation of leaf and berry pulp extract of *H. salicifolia* and *H. rhamnoides* on suitable cancer cell lines.
- Morphological and microsatellite based biodiversity analysis of seabuckthorn (*Hippophae rhamnoides*, *Hippophae salicifolia*, and *Hippophae tibetana*) natural populations, from distinct geographical regions of Indian Himalayas (*Union Territory of Ladakh, Himachal Pradesh, Uttarakhand, and Arunachal Pradesh*)
- Gender-based molecular markers identification and validation in seabuckthorn (*Hippophae rhamnoides* and *Hippophae salicifolia*)
- Functional validation of miRNA target genes in abiotic stress in *Hippophae salicifolia*
- NGS based construction of transcriptome assembly of *Hippophae salicifolia* male and female plants

本学院的研究领域广泛，近期集中于以下方面：

- (1) 喜马偕尔邦、拉达克和阿鲁纳亚邦（注：我国藏南地区，下同）沙棘代谢组多样性；
- (2) 柳叶沙棘的叶和果实提取物抗氧化特性比较研究；
- (3) 在合适的癌细胞上开展柳叶沙棘、鼠李沙棘的叶和果实提取物的细胞毒性评估；
- (4) 印度喜马拉雅地区鼠李沙棘、柳叶沙棘、西藏沙棘天然种群基于形态学和微卫星的生物多样性分析；
- (5) 鼠李沙棘和柳叶沙棘基于性别的分子标记物鉴定和认证；
- (6) 柳叶沙棘非生物胁迫 miRNA 靶向基因功能认证；
- (7) 基于 NGS 构建柳叶沙棘雌株和雄株转录基因集成。

In our recent work, we have done biochemical profiling in seabuckthorn from Himachal Pradesh, Union Territory of Ladakh, and Arunachal Pradesh. We used two major spectroscopy techniques i.e., GC-MS and ¹H NMR to generate metabolome profiles of seabuckthorn collections from diverse geographical locations in seabuckthorn. The multivariate analysis was performed on the spectral data obtained using GC-MS and ¹H NMR for the identification of metabolomic discriminators for different regions. The different origins of leaves and berries showed discrimination based on formation of separate cluster. The correlation analysis was performed on berry samples from Himachal Pradesh and Union Territory of Ladakh at varying altitudes and temperatures.

The study found a strong inverse relationship between the altitude and a positive relationship with temperature of collection sites and the total quantity of metabolites. The huge range of metabolites identified from various locations using both GC-MS and ¹H NMR in different collections of Indian Himalayas could be useful for the assessment of food safety and the quality of different food products, nutraceuticals, pharmaceuticals, and cosmeceuticals. Furthermore, the knowledge gathered in this study may be useful to industrialists in addressing the demand for metabolites in order to create better products.

Comparative analysis of antioxidant properties of leaf and berry extract of selected *H. rhamnoides* and *H. salicifolia* collections revealed that *salicifolia* berries could be a good source of natural antioxidants. Finally, the effect of leaf and berry pulp extracts of *H. salicifolia* and *H. rhamnoides* on breast and lung cancer cell lines was studied for deriving information for development of herbal medicines. The cytotoxicity assay (MTT) revealed that *H. salicifolia* berries could be a better source for the treatment of breast and lung cancer.

近期，我们开展了喜马拉雅邦、拉达克和阿鲁纳亚邦的沙棘生化分析。我们主要应用用 2 种波谱技术 (GC-MS 和 ¹H NMR) 来研究不同地区沙棘的代谢组。对 GC-MS 和 ¹H NMR 波谱数据进行多变量分析，以识别不同地区沙棘代谢组差异。不同地区的沙棘叶片和果实样品明显区分在不同簇中。基于喜马拉雅邦和拉达克地区的不同海拔和温度下的果实样品进行了相关性分析。

结果表明，总代谢与采集地的海拔呈强烈负相关，与温度呈正相关。通过 GC-MS 和 ¹H NMR 对印度喜马拉雅地区沙棘种群代谢长系列分析，有益于评估当地食品安全和食品、营养补充剂、药品、化妆品等的质量。同时，该研究的相关文献资料将有助于工业企业开发更好的沙棘产品对沙棘代谢物的需求。

通过对鼠李沙棘、柳叶沙棘的果实和叶提取物抗氧化特性的比较分析，结果显示柳叶沙棘果实是一种天然抗氧化剂来源。最后，开展了柳叶沙棘和鼠李沙棘的叶及果渣提取物对乳腺癌和肺癌细胞株的作用研究，以便为草药开发积累资料。植物毒性分析 (MTT) 表明，柳叶沙棘果实将是乳腺癌和肺癌疗的一种理想原料。

The environmental variations prevailing in the areas covered in the study have a determining effect on genetic diversity as revealed by the data on 27 morphological characteristics and 16 microsatellite markers. Overall, it was evident that molecular markers are more efficient tools to assess the genetic variability in comparison to morphological characters. Our findings suggest that a significant level of diversity is available in seabuckthorn offers ample scope of improvement in seabuckthorn through focused breeding and conservation programs.

We have generated whole transcriptome profile of male and female *H. salicifolia* leaf samples using NGS approach, to discriminate the data and analysis the mechanism responsible for the gender discrimination. The transcriptome assembly was exploited for microsatellites distribution, presence of various transcription factors, functional annotations of the whole assembly, in silico differential expression of genes and their experimental validations. Assigning functional annotation to the seabuckthorn transcriptome revealed the conservation of genes involved in various biological, cellular, and molecular processes.

This pioneering study of the gender-specific transcriptome of *H. salicifolia* will provide an opportunity to understand the DEGs and the associated regulatory mechanisms involved in the determination of sex in seabuckthorn and related species.

27 个形态特征和 16 个微卫星标记的分析结果表明，环境变化对研究区域的遗传多样性具有决定性影响。总之，与形态学特征相比，分子标记是评估遗传变异性的更有效工具。我们的研究结果表明，通过重视育种和保护，沙棘现存的显著多样性为沙棘遗传改良提供了充足的种质资源。

利用新一代测序技术，获得了柳叶沙棘雄性和雌性叶片的完整转录组，为性别分化机理研究提供有效数据。利用转录组数据进行微卫星分布、各种转录因子的发掘、组装和功能注释、基因差异表达分析以及实验验证。通过沙棘转录组功能注释，解析了沙棘在各种生物、细胞和分子过程中基因的保守性。

对柳叶沙棘性别转录基因的开创性研究，将为解析沙棘及相关物种性别分化过程中涉及的差异表达基因 (DEGs) 及其相关调控机制提供良好机会。



Recent publications on seabuckthorn

1. Chaudhary, P and Sharma, PC (2022) "Functional validation of miRNA target genes in abiotic stress in *Hippophaesalicifolia*". *Bioinformation* 18(1): 61-65 (Published Online: <https://doi.org/10.6026/97320630018061>)

2. Chaudhary, P and Sharma, PC (2022) "Microsatellite Polymorphism in Relation to Geographical Distribution and Adaptation of Seabuckthorn (*Hippophaerhamnoides*L.) in the Indian Himalayas". *Current Trends in Biotechnology and Pharmacy* 16 (1): 1 –13 <https://doi.org/10.5530/ctbp.2022.1.1>

3. Chaudhary, P and Sharma, PC (2022) "Distribution of simple sequence repeats, transcription factors, and differentially expressed genes in the NGS-based transcriptome of male and female seabuckthorn (*Hippophaesalicifolia*)". *Journal of Biomolecular Structure and Dynamics* <https://doi.org/10.1080/07391102.2022.2034669>

4. Jain, A, Kumar, A and Sharma, PC (2022) "Morphometric and Microsatellite Diversity in Seabuckthorn (*Hippophaerhamnoides* L.) Natural Populations Originating from the Different Geographical Regions of the Indian Himalayas". *Plant Molecular Biology Reporter Plant Molecular Biology Reporter* <https://doi.org/10.1007/s11105-022-01338-6>

5. Singh, S and Sharma, PC (2021) "Gas chromatography-mass spectrometry (GC-MS) profiling reveals substantial metabolome diversity in seabuckthorn (*Hippophaerhamnoides*L.) berries originating from different geographical regions in Indian Himalayas". *Phytochemical Analysis* 33(2): 214-225. <https://doi.org/10.1002/pca.3081>

6. Singh, S and Sharma, PC (2022) "¹H Nuclear Magnetic Resonance (NMR)-based Metabolome Diversity of Seabuckthorn (*H. rhamnoides*L.) berries originating from two geographical regions of Indian Himalayas". *Food Analytical Methods* 15: 157-171. <https://doi.org/10.1007/s112161-021-02100-6>

(近期发表论文: 中文译文略)





Study of *Hippophae salicifolia*
from Arunachal Pradesh

阿鲁纳亚邦的柳叶沙棘研究

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In the current study, a survey was done in various regions of Arunachal Pradesh. *H. salicifolia* has been found growing naturally in Tawang district of the state. It is reported along the basins of river Naymjang Chu in Zemithang valley (27° 04' 36" and 91° 04' 25") having an altitude of 8000 ft above msl which is located approximately 100 Km away from Tawang city. It is spread in an area of about 5 km along the river banks. The natural plantation is in the plains, sandy soils of river basins only and absent on the hills & rocky soils. A preliminary study has been carried out for its distribution, botany and ethnobotanical uses. The detailed study is divided into following objectives:

据目前完成的阿鲁纳亚邦（我国藏南地区）沙棘分布调查结果，柳叶沙棘天然分布在 Tawang 地区，在沿着 Naymjang Chu 流域的 Zemithang 河谷，距离 Tawang 城约 100 km、海拔 8000 英尺的区域，沙棘分布在 5 km 长的河两岸。沙棘只是天然生长在河流平缓、砂质土地上，在山地岩性土地不生长。对其资源分布、植物学、民族植物学应用的初步研究已经开展，详细研究主要围绕以下 4 个方面。

6.1 Botany and diversity study of the specie.

植物种类和多样性研究

- A detailed morphological studies of the plant has been carried out.
- The natural growing population of *H. salicifolia* in Zemithang is dioecious, deciduous, perennial bushes to tree, about 2m to 6m high and 50 cm in diameter with a thick grey crown.
- The leaves are small, usually 6 to 8 cm long and 1 to 1.5 cm broad, alternate, linear, lanceolate in shape and covered with silvery stellate scales on the backside.

- (1) 开展了植物细化形态学研究；
- (2) 天然种群柳叶沙棘株高 2-6m，直径 50cm，浓密灰色树冠；
- (3) 叶片小，6-8cm 长、1.5cm 宽；

- Fruit ripening sets in during the month of October. The fruits (5 to 7 mm in size) are generally round, pale green in colour and turn golden-yellowish brown on ripening. The fruits have a soft skin covering the juicy pulp and a small, hard, oval seed.

(4) 果实 10 月成熟, 大小 5-7mm, 近圆形, 成熟时呈黄褐色。

6.2 Biochemistry and nutraceutical studies

生物化学及营养药学研究

- Physico- biochemical studies of the fruit and fruit pulp and mineral analysis of the leaf such as Iron, calcium, potassium, magnesium, manganese has been already carried out.
- Nutritional studies & physico-biochemical analysis on pulp of different trees samples/ accessions has been carried out.
- Storage and stability study of pulp at different temperature i.e. 40 °C , room temperature, 4, -20°C (Parameters: Vitamin C, Titrable acidity, pH, total sugar & reducing sugar and microbiology) for six months has been carried out.
- In vitro antioxidant activity studies of different leaf extracts has been carried out.

(1) 开展了果实和果肉的生理生化研究, 以及叶片矿物元素分析;

(2) 开展了不同植株果肉样品的生理和生物化学分析、营养学研究;

(3) 开展了不同温度条件下果实储藏 6 个月的营养成分 (Vc、滴定酸、pH 值、总糖、微生物等指标) 稳定性研究;

(4) 开展了沙棘叶提取物活体抗氧化活性研究。

6.3 Propagation and cultivation studies

苗木繁育与栽培研究

- Study on propagation of *H. salicifolia* through cuttings has been carried out.
- Plant material used for the propagation are soft/semi-wood and hard wood cuttings.
- Study shows that IBA (200ppm) and IBA (100ppm) is best for the male and female cutting respectively. Semi-hardwood cutting is better and male cuttings are more responsive than female cuttings.

(1) 开展了柳叶沙棘嫩枝、硬枝、半木质化扦插育苗研究;

(2) 结果显示, IBA (200ppm) 和 IBA (100ppm) 浓度的激素使用分别对雄株和雌株扦插效果最佳, 半木质化扦插效果更好; 雄株插条优于雌株插条;

- Biotechnological aspects such as early detection of male and female plants.
- Being a dioecious perennial, male and female *H. salicifolia* trees cannot be differentiated until the berries appear, which generally requires 5–7 years after seed germination.
- Thus, to develop an easy-to-use molecular method to differentiate staminate from pistillate genotypes at the seedling stage was undertaken.
- This study was aimed at identifying gender-specific polymorphic genetic regions in ISSR fingerprints generated from male and female genomic DNA.

（3）研究了鉴别沙棘雌雄株的生物技术

（4）作为多年生落叶植物，需要种子发芽后 5–7 年开始结果后才能区分雌雄株；

（5）用分子生物学手段开发鉴别雌花和雄花基因型得分简易方法，目的是根据雌株和雄株指纹图谱遗传基因，对苗木早期性别鉴定。

6.4 Nanoparticle studies: Green synthesis of nanoparticles using extracts of *H. salicifolia* leaves, pomace, roots and fabrication of nanocomposite for water treatment.

纳米技术研究

- Objective of the study was preparation and development of green nanocomposite using extracts of *H. salicifolia* leaves, roots and pomace for water treatment.
- Silver nanoparticle has been prepared using aqueous extracts of pomace and leaves of *H. salicifolia*.
- Antibacterial activity of nanoparticles was analyzed and found to show antibacterial activity against *E. coli*.
- Characterization of nanoparticles is in progress.

（1）研究目的是利用柳叶沙棘的叶、果渣、根进行纳米颗粒绿色合成，制造用于水处理的纳米合成物；

（2）制成了利用沙棘果渣和叶片的水溶剂提取物银色纳米颗粒；

（3）开展了纳米颗粒的抗菌活性分析，显示出抗 *E. coli* 大肠杆菌活性；

（4）纳米颗粒特征鉴定正在进行中。



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7.1 The Introduction

Seabuckthorn (*Hippophae salicifolia*) is one of the fascinating and valuable plant species of Sikkim. In Sikkim Himalayas, the cold deserts occur in Lachen and Lachung of North district of Sikkim, a high altitude region of the state. The total geographical area under cold deserts is about 30% of the total geographical areas of the state. These areas have very difficult terrains with ice fields, perpetual snow covered peaks and extreme and hostile climatic conditions. The largest part of the family of Lachung and Lachen depends upon their sustainability in tourism but that is also totally disturbed by very bad management of roads.

In Sikkim, approximately total 1400 hectares of wild economically potential Seabuckthorn forest is lying untapped from many decades in North Sikkim (Fig. 7). Lakhs and lakhs tons of Seabuckthorn fruits and leaves are decaying and mixed in soil every year. If we see through economically thousand crore of rupees of Indian economy is mixed with soil every year. Even it has huge demand in national land international market it is lying unused because of nonintervention of scientific input/studies, due to lack of proper guidance and management, we are not able to use Golden Tree (Seabuckthorn) of Sikkim for betterment of human use.

引言

柳叶沙棘是锡金邦的一种神奇而珍贵的植物树种。在锡金邦北部的 Lachen 和 Lachung 属于喜马拉雅高海拔寒冷荒漠地区，约占整个锡金邦面积的 30%，这些地区气候环境极端恶劣，冰雪覆盖山顶。Lachen 和 Lachung 的大部分居民依赖当地旅游业可持续发展，却又受到路况差的严重影响。

在锡金北部，大约分布有 1400 公顷的几十年未受经济利用的天然沙棘林（见图 7），大量的沙棘果实和叶子每年自生自灭，从印度经济上看，相当于成千上万卢比埋入泥土中。尽管国内外市场需求巨大，由于缺乏科技研究投入和有效的管理指导，至今没有利用这一“金树”造福锡金邦百姓的生活。

Most of the farmers/people of Lachen and Lachung are not aware about importance of highly potent medicinal plant *H. salicifolia*, the only most widely distributed species in Sikkim. It has huge demand in national and international market. Even its raw material has huge demand for production of end numbers of products like cosmetic, Seabuckthorn seed oil, bakery products, nutrient supplement, juice, tea, candy etc.

In Sikkim it is traditionally used in preparation of fruit juice dyes, pickles and some medicinal uses. Especially in north Sikkim, Lachung, Lachen and surrounding areas have very good scope for Seabuckthorn production due to its favorable habitat and sufficient hectares of barren land lying unused from many decades. Sikkim Supreme, a Sikkim Government food processing unit is preparing Seabuckthorn ready to serve (RTS) juice and seabuckthorn leaves tea. Lot of local entrepreneurs are interested in processing Seabuckthorn fruits and other plants materials to make different products from the Seabuckthorn plants because of its high market demands.

Lachen 和 Lachung 的大多数居民没有认识到在该锡金最广泛分布的柳叶沙棘具有的重要药用价值。作为原料生产加工沙棘化妆品、沙棘籽油、烘焙食品、营养补充剂、果汁、茶叶、糖果等系列终端产品，在国内外市场需求旺盛。

锡金邦传统上，沙棘用于制作水果色素、酸菜和一些药用，尤其在锡金北部的 Lachen 和 Lachung 和周边地区，由于适宜种植沙棘的荒地多，具有良好生长环境，因而有着良好的发展前景。Sikkim Supreme 作为锡金邦政府食品生产机构正在加工鲜榨果汁和沙棘叶茶，许多当地企业因认识到很好的市场需求，对利用沙棘果实和其它植物原料生产系列沙棘制品产生浓厚兴趣。

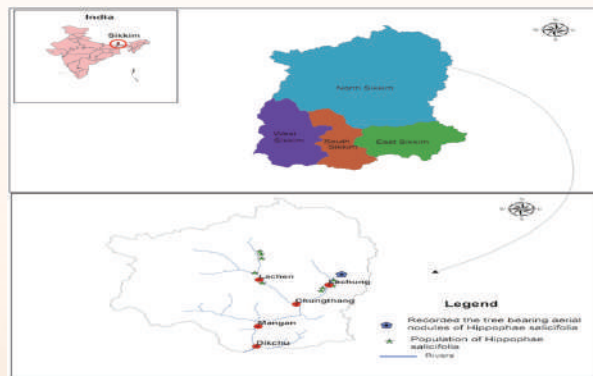


Fig. 7: Seabuckthorn growing areas in Sikkim.
图 7 在锡金的沙棘生长分布区

Seabuckthorn will be the next source of income for them, if we provide scientific input, technical supports, proper guidance and management and end numbers of training on following areas like harvesting of Seabuckthorn fruits and leaves, agro techniques of Seabuckthorn, primary and secondary processing of raw materials, development of different products etc. We have to show them systematically how their economy will grow from Seabuckthorn plants and supports their livelihood with sustainable manner. Globally, the ethnic knowledge of wild medicinal plants is declining gradually, efforts are made to educate the upcoming generation about the importance of bio resource of nation; otherwise it may be lost in the near future. Hippophae salicifolia is one of the most valuable plants of Sikkim state which has of its rich medicinal and ecological importance. (Fig.8)

如果增加科研投入、技术支持、合适的管理指南, 以及诸如沙棘果实和叶片采收、农作技术、原料初加工和二次加工、系列产品开发等培训, 沙棘将为当地居民增收提供另一条途径。我们应该系统向村民展示如何通过沙棘植物资源提高经济水平、改善家庭生活。从全球视角看, 天然沙棘植物的民族药用知识正在逐渐丧失, 应努力教育下一代有关生物资源对民族的重要性, 否则将会在不久而消失。柳叶沙棘具有丰富的药用和生态价值, 是锡金邦最有价值的植物之一。(见图8)



Fig. 8: Seabuckthorn forest in Sikkim
图 8: 锡金邦的沙棘林

7.2 Seabuckthorn Industries and Business

沙棘加工和贸易

Zeon Lifesciences Limited,

company incorporated under the companies Act 1956 is in business of manufacturing and supply of Nutraceuticals and Ayush product with strong background of R&D experts. Zeon have state of art DSIR approved R&D facility of 40+ Scientist. Its Quality Lab is NABL accredited. Client's product, formulas or ideas all can be turned into a leading market brand with the support and expertise of knowledgeable scientists and research team who assists in designing innovative formula that is unique and cost-effective.

Zeon is an End-to-End researched-driven preferred manufacturing partner for Nutraceutical, Ayurvedic, Phytopharmaceuticals, Medical Nutrition, Sports Nutrition, Health and Wellness products and value-added-ingredients. It is leader in finished formulations and quality ingredients with focus on extensively researched products. It offers a complete bouquet of manufacturing and developmental solutions to meet the ever-changing market demand.

(1) Zeon 生命科学有限公司

依据 1956 年《公司法》，该公司属于具有雄厚研发基础的功能食品和阿育吠陀制品生产供应企业，拥有 DSIR 批准的先进研发设施，有 40 多名科学家，质量控制实验室具有 NABL 信用资质。在专业科研团队的技术支撑下，顾客需求产品和配方能够迅速转变为产品独特创新、成本效益显著、引领市场的品牌产品。

Zeon 公司属于功能食品、阿育吠陀传统医药、植物制药、医学营养、运动营养、健康福利产品及增值成分的高端研发加工伙伴，在深度研发成品配方、高质量成分产品上居于领先地位，具备满足不断变化市场需求的开发、生产完整的一揽子解决方案。



Zeon's journey started in 1987 and with three decades of experience it has advanced its systems and institution to deliver the absolute highest quality of Nutraceutical and Wellness products to every client, on time and at an unsurpassed value.

With a futuristic vision and strong belief in Industry-Academia-Collaboration, Zeon has collaborated with various reputed research driven organization to foster innovation in the field of Nutra, Wellness and Ayurveda. In line of collaboration, Zeon has associated with CSIR-IIIM Jammu, DPSRU, New Delhi, NIPER Mohali, BITS Pilani, Rajasthan, SRM University Chennai, Adesh University, Bhatinda, CCMB Hyderabad, UPES, Dehradun and IMS BHU, Varanasi for conducting quality research, pre-clinical & clinical studies on innovative products. Our belief is that collaboration between Industry and academia is key to catalyse innovation and growth in technology. While industry mainly focuses on addressing solutions that are of commercial value and academia focuses on building new knowledge through research and imparting education to students. Most of the technologies developed by the Institutions does not go for commercial because of lack of a platform. Therefore, the combination can yield accelerated development of new breakthroughs. The interdependent research relationships between universities and company enable both entities to sustain growth in their areas. While companies rely on university researchers for product innovations, faculty gain prestige through increased external research funds.

Zeon Lifesciences have worked on successful commercialization of different technologies and health products in collaboration with institutions as well as other National & International companies. Zeon has also signed agreements with companies like Vitonnix, UKOptibiotix, UK, GLN Laboratories USA (Subsidiary of IMAC, USA) & AP Organics, India (Group of Ricela) for development of clinically validated products with novel ingredients, delivery system & technologies.

Zeon 公司成立于 1987 年，已有 30 多年历史。具备满足每一客户对最高品质功能食品和健康产品需求的先进系统和机构，提供准时、不可超越的价值服务。

基于前瞻性视野和产业与学术合作坚强理念，Zeon 公司与知名研究机构建立合作，推进功能食品、健康制品、阿育吠陀产品创新，先后与嘉木 SIR-IIIM、新德里 DPSRU、莫哈里 NIPER、拉贾斯坦 BITS、金奈 SRM 大学、Adesh University 等合作，开展高质量的创新药品的临床前及临床研究。公司秉持一个理念，即产业与学术合作是加速技术创新与发展的关键。产业重点关注商品价值实现，而学术关注通过研究建立新知识并完整传授给学生。研究所开发的大多数技术没有转化为商业，是因为缺少一个平台。因此，两者的结合便可加快新突破，大学和企业两者相互独立关系保障两者在各自领域持续发展，一方面公司依托大学研究人员进行产品创新，另一方面大学教员通过得到持续的外部研究经费而获得声誉。

Zeon 生命科学公司与其他研究所及国内外企业合作，成功开展了许多技术和保健产品商业化，先后与 Vitonnix、英国 Optibiotix 和 GLN 实验室、美国 IMAC、印度 Ricela 集团等签订合作协议，共同开展创新成分的临床验证及技术推广。

Zeon Lifesciences is also in similar line with Govt. of India drive focus on to growth of Nutraceutical market in India and become global leader in same field. Nutraceutical market is expected to grow \$ 100 Billion in upcoming years. Governing agencies like FSSAI & AYUSH are working in collaboration with nutraceutical industries to make this possible. BIRAC and AIC promoting innovation & start-ups by providing funds. World Health Organization laid the foundation of Global Centre for Traditional Medicine GCTM in Gujrat first and only global outpost across the world in May 2022.

Zeon 生命科学公司按照印度政府的指南，致力于印度功能食品市场开发并在全球处于领先地位。预计下一年全球功能食品市场将增加 1000 亿美元，FSSAI 和 AYUSH 等印度政府机构正在与产业合作，帮助其实现目标。BIRAC 和 AIC 提供启动和创新基金。2022 年 5 月，世界卫生组织在 Gujrat 首次设立了世界传统医学中心 GCTM。

7.3 Products Developed by Zeon Life Sciences Ltd. Zeon 生命科学公司开发的产品

- 1) Polyherbal formulation along with Seabuckthorn Ext. (Recommended for Neurodegenerative Disorder).
- 2) SCP as adjuvant therapy for prophylaxis of COVID-19.
- 3) Fermented Seabuckthorn Pulp Powder for Brain Health.

- (1) 沙棘提取物与多种草药复方（推荐用于脑退化疾病）；
- (2) SCP 辅助治疗新冠肺炎预防；
- (3) 沙棘发酵果粉用于大脑保健。

7.4 Key Findings on Innovative Research

1) Polyherbal formulation along with Seabuckthorn Ext.
The product is a poly herbal formulation of Seabuckthorn Fruit Extract along with other potential herbs (Fig. 9). There are several bio molecules (biomarkers) present in the formulation which have therapeutic potential in the prevention and management of neurodegenerative disorders. Our formulation has already been patented in US and EU and proven clinically for its benefits. This product has validated by IPC, Ghaziabad for its quantitative analysis and find compliant as per specification. The products have approved by FSSAI for manufacturing and selling in to India and Global Market. As well as close discussion with AYUSH (CCRAS, Govt. of India) for approval with all major claims.

主要研发创新成果

(1) 沙棘提取物与多种草药复方。该产品是由沙棘果实提取物与其他功能草药制成的复方（见图 9），其中含有可预防和控制大脑功能退化疾病有治疗效果的一些生物分子（生物靶）。该复方在美国、欧盟获得专利并得到临床验证有效。Ghaziabad 的 IPC 根据量化分析和正向结果已批准该产品，FSSAI 同意产品生产并在印度和国外市场销售，还就批准相关请求与 AYUSH（隶属于印度政府 CCRAS）深入交换意见。

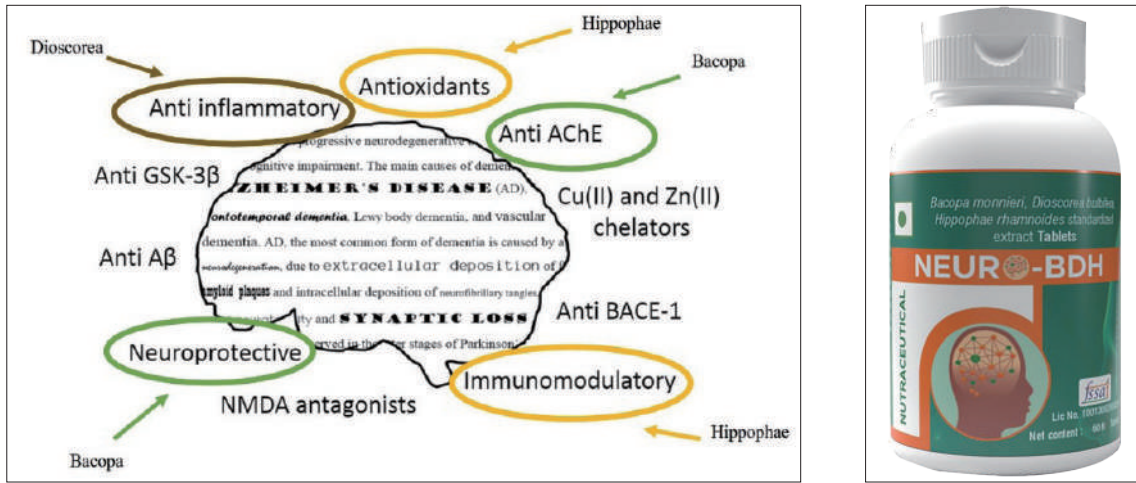


Fig. 9. Treatment Approach of Polyherbal Formulation for the prevention of SDAT.
图 9 沙棘草药复方预防 SDAT 的作用途径

1) SCP Blend as adjuvant therapy for prophylaxis of COVID-19: Patent pending.

We develop a synergistic combination of Natural Ingredients (Nano Curcumin + Fermented Seabuckthorn Pulp + Pine bark Extract) using novel delivery technologies to increase its efficacy in synergy, for immunomodulatory effect and antiviral activity. We conducted acute oral toxicity study in animal model (rats) using OECD 423 guidelines where rats were administered orally and observed for clinical signs, behavioural and gross pathological studies individually. The studied dose did not cause any mortality or signs of toxicity in the rats tested during the observation period. Beside this, another study was conducted for Bacterial reverse mutation test using 5 different strains of Salmonella typhimurium: TA 98, TA100, TA102, TA1535 and TA1537. The product was tested at different concentrations by direct plate incorporation method and by preincubation method, where this poly-herbal formula, did not exhibit mutagenicity with bacterial reverse mutation at the tested concentrations under the test conditions.

Immunomodulation and anti-inflammatory properties of the formulation, which exhibited

(2) SCP 辅助治疗新冠肺炎预防 (专利审查中)。公司开发一款天然成分协调复合配方 (纳米姜黄 + 沙棘发酵果肉 + 松树皮提取物), 应用创新技术提高免疫调节和抗病毒协同功效。通过 OECD 423 规则下的大鼠动物模型口服急性毒性研究, 对大鼠口服样品, 分别观测临床指标、行动表现和病理学研究。结果表明, 口服实验剂量下没有导致观测期间实验大鼠的死亡或中毒现象。此外, 还开展了 5 个不同细菌毒株 Salmonella typhimurium: TA 98、TA100、TA102、TA1535、TA1537 的逆向变异实验, 采用“直接平板结合法”和“细菌预培养法”进行不同浓度实验, 结果表明, 在实验条件、实验浓度下该复合草药配方没有产生细菌逆向突变现象。

该组方的免疫调节和抗病特性观测, 表现出对 LPS 诱导小鼠 TNF- α , IL-1- β , MIP-

protection against LPS induced TNF- α , IL-1- β and MIP-1- α in mouse dendritic cell line was also observed and this was compared with Dexamethasone which was a glucocorticoid medication. Under Florescent microscope, the process of phagocytosis is observed minimally in the treatment groups compared against the LPS-cell control. The compounds therefore have little effect on the phagocytosis in the cell lines.

Develop formulation was enhancing the rate of carbon clearance (phagocytic activity) when compared to that of normal control and standard group (Dexamethasone). Anti-viral activity of Formulation with viral RNA extraction was conducted & it showed very promising results with approx. 57 % viral reduction using Vero cell line in BSL-3 Laboratory (CCMB Hyderabad).

Based on the findings of above studies it is evident that the formulation shows multiple pharmacological activities. Immunomodulatory, Antiviral, Anti-Inflammatory are the major therapeutic effects which have been performed by the Polyherbal Formulation with goodness of seabuckthorn (Fig. 10).

1- α 的保护作用，并与用于治疗肾上腺皮质激素糖原的药物 Dexamethasone 进行对比，显微镜观察了以 LPS 细胞作为对照处理组轻微的噬菌过程。可见，该成分对细胞株噬菌影响是轻微的。

以正常对照及标准组(药物 Dexamethasone)作对照，改进后配方强化了碳清除率(噬菌活性)。同时开展了含病毒 RNA 提取物配方的抗病毒活性实验，取得良好效果，BSL-3 实验室 (CCMB Hyderabad) 中 Vero 病毒细胞减少约 57%。

上述结果表明，该配方案具有很好的药物活性。结合沙棘的特性，多味草药复方显示出良好的免疫调节、抗病毒、抗炎疗效。(见图 10)

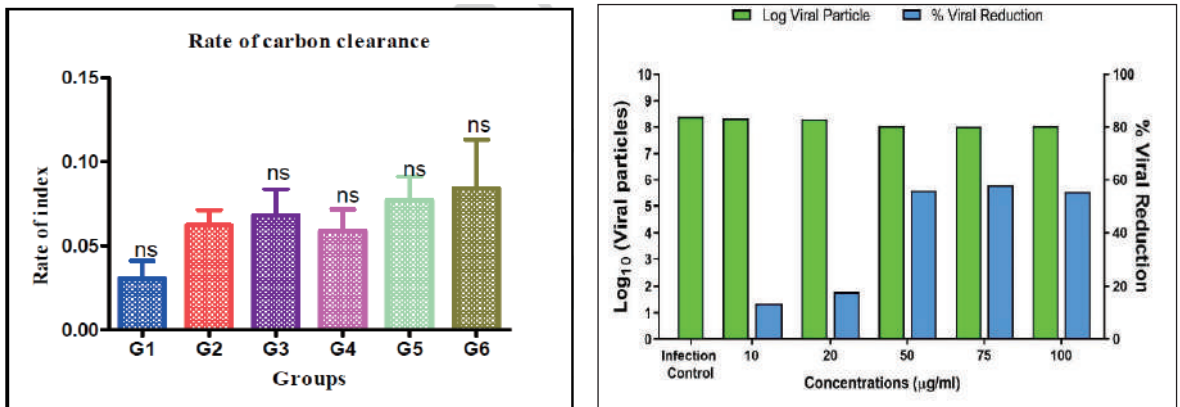


Fig. 10. Formulation showed 57 % viral reduction at 50, 75,100 g/ml. The viral particles reduce from Log 108.4 to Log 10 8.0

图 10: 配方显示病毒减少 57%

3) Fermented Seabuckthorn Pulp Powder for Brain Health:

Seabuckthorn pulp was fermented using proprietary technology and find out four biomarkers for therapeutic benefits. This product is under preclinical and clinical studies for safety and efficacy for brain health.

(3) 沙棘发酵果粉用于大脑保健。利用专利技术发酵沙棘果肉，发现 4 种具有疗效的生物靶。该产品正在进行对脑健康安全、有效性的临床前期和临床研究。



Seabuckthorn Oil and Value Added Products 沙棘油及其附加值产品介绍

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Seabuckthorn is known as a Panacea, or Cure-all by the power of 190 phytonutrients carrying 14 essential vitamins, whole spectrum of Omega (3, 6, 7 & 9) including highly bioactive & rarely available Omega-7, super charged anti-oxidants and hundreds of other nutrients. Sea buckthorn is THE supplement. It's as if one combined fish oil with a multi vitamin/mineral all from one fruit. To make matters better, this is vegan friendly.

沙棘是被称为是一种医治百病的“灵丹妙药”，富含 190 多种活性物质、14 种必须维生素、Omega (3, 6, 7 & 9)，以及具有极强抗氧化活性的物质和几百种营养成分。沙棘是一种良好的补充剂，似乎一个沙棘果实中就集合了鱼油中含有的多种维生素和矿物质。

Nutraceutex is in the business of Seabuckthorn oil extraction from Whole Berry-Fruit-Seed-Pulp-Leaf by using state of the art, toxin-free, highly selective greener Supercritical Fluid Extraction (SCFE) and allied novel technologies to produce superior quality natural extracts and high efficacy novel end products. (Fig. 11)

Nutraceutex 致力于通过现代超临界液相提取工艺从沙棘全果、果皮、叶提取无毒沙棘油，配以其他创新技术加工高品质、高效能的天然制品。(见图 11)

STRENGTHS

- Intellectual Property -3Patents,3Brands, 3Trade marks
- Novel technologies-3Novel Process technologies for high end bio active products
- Innovative Products- 3 Category extracts(Sea buckthorn,Spices,Food) based 51 products registered with FSSAI in 3 formats (Liquid, Powder, Capsules).
achieved up to 50% omega-7 in Fruit Pulp oil
- ORGANIC & FDA- Sale of 6-7 tonne seabuckthorn oil to USA in a year.
- National Award-Promoter Pawan Kamrais National award Winner of seabuckthorn processing.

企业具有以下优势:

- (1) 知识产权: 拥有 3 项专利、3 个品牌、3 个注册商标;
- (2) 创新技术: 3 项加工高端生物活性产品的创新生产工艺;
- (3) 创新产品: 基于三大类提取物的 51 种产品;
- (4) 有机认证/FDA 认证: 每年向美国出口 6-7 吨沙棘油;
- (5) 国家级获奖: Pawan Kamrais 国家奖获得者。



Fig. 11. Seabuckthorn supercritical Co2 extraction Unit, Baddi, HP (website: www.nutraceutex.com)

图 11. 沙棘油超临界二氧化碳萃取装置

8.1 Biosash Business Private Limited

Plot No 6, Gurukul Industrial Area, Sector 38, Faridabad 121003, Haryana, India
Corporate Office: Vatika Mindscapes Tower B, Unit 9, Ground Floor, Sector 27, Faridabad, Mathura Road, Next To Sarai Metro Station, NCR of Delhi
Contact with: Arjun Khanna, MD (Email: ajkhanna999@gmail.com, Tel: +91-9999347167)

Biosash 私人商业有限公司

地址：印度哈里亚纳邦 Faridabad 38 区 Gurukul 工业开发区
联系人：Arjun Khanna

8.2 Seabuckthorn business and trade by Biosash

Biosash Business Pvt Ltd is a company with turnover of approx. Rs 600 million annually mainly in seabuckthorn products (Fig. 11). Biosash already has products from tea, toothpaste and green tea to juices, capsules, jam . sauces to creams and oils for daily use and when anyone uses any product once they do not change the product ever again.

Biosash 公司商贸业务

公司年产值约 6 亿卢比，主要沙棘产品 (见图 12)，包括茶叶、绿茶、果汁、果酱、牙膏、胶囊，日化用油、面霜。

8.3 Seabuckthorn products by Biosash

- 18 Different Seabuckthorn Juices for lifestyle induced conditions such as Type 2 Diabetes, Ulcers, poor Immunity, and for sportsmen and athletes & women.
- Seabuckthorn Chawanprash or Chawanprash based on the goodness of Seabuckthorn
- Numerous Cosmetics, body scrubs, Soaps, and oils
- The worlds first Seabuckthorn Lipsticks
- TALCUM POWDER with Seabuckthorn
- SEABUCKTHORN Toothpaste
- Hand wash
- Hand Sanitiser
- Mosquito repellants
- Seabuckthorn Trimfit Tea
- Seabuckthorn Honey Corn Flakes
- Seabuckthorn Tomato Chilli Sauce
- Seabuckthorn Nutrition bars
- Seabuckthorn Liquid Laundry Detergent
- Floor Cleaner
- Dish wash
- Multipurpose household Cleaner

Biosash 公司产品介绍

(1) 18 种针对生活方式导致不良影响的功能性沙棘果汁：II 型糖尿病、溃疡、免疫力低下、运动员、妇女等人群。

(2) 产品包括：沙棘咀嚼片、沙棘肥皂等系列化妆品、唇膏、爽身粉、牙膏、洗手液、消毒液、驱蚊剂、保健茶、玉米片、西红柿辣椒酱、营养棒、液态清洁剂、地板清洁剂、洗碗液、多功能室内清洁剂。

Mr Arjun Khanna has been honoured with an international award by International Seabuckthorn Association in 2015, for his immense contribution to the development and spread of Seabuckthorn products in the world. He was also special invitee to The 8th International Seabuckthorn Conference, 2018 held in China by the International Seabuckthorn Association and was the sole representative of Industry from India there.

公司负责人 Arjun Khanna 先生于 2015 年荣获国际沙棘协会颁发的国际奖，表彰其在推动国际沙棘产品传播所作的杰出贡献。他作为印度企业界的特别代表，应邀出席了 2018 年在中国举办的第八届国际沙棘大会。



Fig. 12. Biosash seabuckthorn products
图 12 Biosash 公司沙棘产品



5. Country Report of Latvia



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Sea Buckthorn Development of LATVIA in 2021

2021 年拉脱维亚沙棘开发报告

The total area of sea buckthorn plantations in Latvia in 2021 was about 1000 ha, 150 ha of them have been certified as organic. The total production of sea buckthorn fruits in Latvia in 2021 was about 700 tons. The impact of our main pest sea buckthorn fly this year was less significant due to unfavorable wintering conditions for larvae.

The main focus in Latvia is on the organic fight against sea buckthorn flies, evaluating different methods of watering and fertigation (research project of three years), as well the testing of the new Siberian varieties in changed Baltic climate (research project of five years). The previous similar test of introduced varieties of the continental origin has been done in Latvia 40 years ago.

Projects on various topics related to sea buckthorn have been continued and started in Latvian scientific institutions. The most important projects:

1. "Processing of sea buckthorn vegetative biomass biorefining", Latvian State Institute of Wood Chemistry, <http://kki.lv/en/institute/about-institute>

The aim of the project: to offer a residue-free innovative technology that will ensure the use of all unique sets of biologically active compounds in sea buckthorn vegetative biomass, in the form of extracts, individual compounds (serotonin, proanthocyanidins) and solid granular complexes,

截止 2021 年，拉脱维亚沙棘种植园总面积约为 1000 公顷，其中 150 公顷已认证为有机种植园。2021 年拉脱维亚的沙棘总产量约为 700 吨。相比去年，由于幼虫的越冬条件不利，今年我们的主要害虫沙棘果蝇对产量的影响不太显著。

拉脱维亚的沙棘重点是有机防治沙棘蝇，评估不同的浇水和施肥方法(为期三年的研究项目)，以及对处于波罗的海气候变化中的西伯利亚新品种(为期五年的研究项目)进行测试。40 年前，拉脱维亚曾对引进的大陆种源品种进行过类似测试。

拉脱维亚科学机构已经持续开展了与沙棘有关的各种课题的项目。最重要的项目有：

1. “沙棘植物生物质的生物精制加工”，拉脱维亚国家木材化学研究所，<http://kki.lv/en/institute/about-institute>

该项目的目标是：提供一种无残留的创新技术，确保沙棘营养性生物量中所有独特的生物活性化合物被使用，以提取物、单个化合物(血清素、原花青素)和固体颗粒复合物的形式。这些化

they will be valuable for national bioeconomy and various international market segments.

2. “Technological solutions for sea buckthorn cultivation in accordance with the principles of organic farming, taking into account three main aspects: control of the sea buckthorn fly *Rhagoletis batawa*, fertilization and watering in commercial sea buckthorn plantations”. Institute of Plant Protection Research “Agrihort” of Latvia University of Life Sciences and Technologies, <https://agrihort.llu.lv/en>

The aim of the project:

- Find the most effective attractant and trap design for catching flies in the field conditions.
- Find the most cost-effective sea buckthorn irrigation technology.
- Find a composition and type of fertilizer suitable for organic farms that ensures crop quality and increases overall yields.
- Evaluate the economic feasibility of these solutions.

3. “Use of innovative methods in increasing the productivity and quality of sea buckthorn plantations”, Institute of Horticulture, <https://www.darzkopibasinstitut.lv/en/about-institute-of-horticulture>

The aim of the project: To develop and practically test an innovative method for increasing the productivity and berry quality of sea buckthorn plantations by growing and incorporating green manure between rows. Until now, the use of green manure and high-quality grassland between rows is

合物对国家生物经济和多个国际细分市场是有价值的。

2. “根据有机农业原则，基于沙棘果蝇的控制、商用沙棘种植园的施肥和灌溉的沙棘栽培技术的解决方案”。拉脱维亚生命科学与技术大学植物保护研究所，<https://agrihort.llu.lv/en>

项目目标：

- 寻找最有效的诱饵和诱捕器设计，以便在野外条件下捕捉沙棘果蝇。
- 寻找最具成本收益的沙棘灌溉技术。
- 找到适合有机农场使用的肥料组成和类型，以确保作物的质量并提高总产量。
- 评估这些解决方案的经济可行性。

3. “使用创新方法提高沙棘种植园的生产力和沙棘果实质量”，拉脱维亚园艺研究所，<https://www.darzkopibasinstitut.lv/en/about-institute-of-horticulture>

该项目的目标是：开发和实地测试一种创新方法，能够在沙棘行间套种绿肥来提高沙棘种植园的产量和果实质量。到目前为止，在拉脱维亚的果树种植中很少使用行间绿肥和优质

little used in the cultivation of fruit crops in Latvian conditions. The most popular and commonly used types of fertilizer in the industry are either the use of mineral fertilizers or manure, or cultivation without additional fertilization. The use of fertilizers is especially topical issue in organic farms.

Description: During the study, the influence of inter-row vegetation on sea buckthorn plantation productivity will be practically examined and the most productive variants of green manure and perennial grasslands will be evaluated, which will provide insight into the use of new agricultural techniques to improve sea buckthorn productivity. For the application of the new method, indicators will be defined that will substantiate the effect of the results on the increase of productivity and increase of berry quality, as well as the desired composition of inter-row plants will be determined, based on soil composition analyzes.

In this project, a Hungarian-made attractant for catching sea buckthorn flies (*Rhagoletis batava*) is tested to see if it is possible to catch more flies if sticky traps are added to the attractant. Trapless attractants are used for comparison. After the end of the project, it is planned to continue research on sea buckthorn pathogens.

4. "Development of sea buckthorn seed oil production technology using supercritical CO₂ extraction", The Joint Stock Company SISTEMU INOVACIJAS, <https://cro.lv/en/>

Objective of the project: Development and verification of high nutritional value sea buckthorn

草地。该行业中最流行和最常用的肥料类型是使用矿物肥料或粪肥，或在额外施肥的情况下种植。化肥的使用是有机农场中特别敏感的话题。

说明: 在研究期间，将实际检测行间植被对沙棘种植园产量的影响，并评估绿肥和多年生草地的最高产的变量，这将为使用新的农业技术提高沙棘产量提供参考。对于新方法的应用，将明确一些评价指标，这些指标能够证实对沙棘产量和果实质量的提高，以及基于土壤成分分析确定理想的行间植物配置。

在这项目中，测试了一种来自匈牙利的捕捉沙棘果蝇的引诱剂，以确定如果在粘性诱捕器中添加诱捕剂是否可能捕捉更多的沙棘果蝇。以无粘性诱捕器的引诱剂用于做对照。项目结束后，计划继续进行沙棘病原菌的研究。

4. “利用超临界 CO₂ 萃取开发沙棘籽油生产技术”，SISTEMU INOVACIJAS 股份公司，<https://cro.lv/en/>

该项目的目标：开发和验证高营养价值沙棘籽油提取方法，使用创新技术 – 超临界液相萃取

seed oil fraction extraction methodology using an innovative technology – supercritical fluid extraction as a solvent using CO₂ .

Description: An innovative methodology will be developed to produce high nutritional value sea buckthorn seed oil fractions out of sea buckthorn residues after juice pressing. This technology is intended to be implemented in manufacturing facility to enhance production efficiency and produce high added value products as ingredient using by-products after juice pressing in order to create zero waste technology.

5.A cooperation project with a private company has been launched with funding from the Latvian Investment and Development Agency. As a result of the research, technologies will be developed for innovative products based on sea buckthorn juice.

Scientific papers:

Dalija Segliņa, Inta Krasnova, Anna Grygier, Elżbieta Radziejewska-Kubzdela, Magdalena Rudzińska, Paweł Górnaś (2021) Unique bioactive molecule composition of sea buckthorn (*Hippophae rhamnoides* L.) oils obtained from the peel, pulp, and seeds via physical “solvent-free” approaches. <https://doi.org/10.1002/aocs.12524>

(CO₂ 作溶剂)。

说明：将开发一种创新方法，从榨汁后的沙棘残渣中提取高营养价值的沙棘籽油。该技术旨在生产设施中提高生产效率，利用榨汁后的副产品为原料生产高附加值产品，从而创造零废料技术。

5. 在拉脱维亚投资和发展署的资金资助下，启动了与一家私营公司的合作项目。通过研究，将开发基于沙棘汁的创新产品技术。

当年发表的科学论文：

Dalija Segliņa, Inta Krasnova, Anna Grygier, Elżbieta Radziejewska-Kubzdela, Magdalena Rudzińska, Paweł Górnaś (2021) , 通过物理“无溶剂”方法从果皮、果肉和种子中提取沙棘油的独特生物活性分子组成。

<https://doi.org/10.1002/aocs.12524>





SBT Variety Marija Bruvele in Latvia 拉脱维亚优良沙棘品种 Marija Bruvele



Yielding plantation of SBT in Latvia 沙棘高产种植园



SBT Rooted cuttings in the nursery Latvia 沙棘扦插育苗苗圃



Trap for SBT flies in Latvia 沙棘果蝇诱捕器

国际沙棘协会（中国）企业委员会会长单位 —— 高原圣果沙棘制品有限公司

Conseco Seabuckthorn Co., Ltd. was founded in 1998 under China National Administration Center for Seabuckthorn Development. The headquarters is in Beijing, and seabuckthorn resources processing base are in Ordos.

Conseco has its own improved seedling breeding base, raw material processing base and marketing system. Conseco has six health products with batch numbers, such as seabuckthorn flavonoids soft capsule, seabuckthorn oil soft capsule and Qingyan capsule, which are of excellent quality and high technical content among the similar health products and are well received by the majority of consumers.

Conseco has passed the health registry of food exporting, the international certificate of ISO9001, HACCP and Kosher, and the certificate of organic food in EU, United States and Japan. The processes including picking, sorting, processing, packing, storage and transportation are strictly followed these international standards. Conseco produced series of seabuckthorn products which be sold all over China and other countries in the world.

In 2019, Conseco was awarded the “President unit of the International seabuckthorn Association”. In 2021, Conseco was honored and became an excellent member of the International Sea-buckthorn Association.

高原圣果沙棘制品有限公司创建于1998年，是水利部沙棘开发管理中心为推动沙棘事业投资创办的国家级沙棘产业示范企业。公司总部在北京，在内蒙古鄂尔多斯建有沙棘资源基地及原料加工基地。

公司拥有自己的良种苗木繁育基地、原料加工基地以及市场销售体系。并且拥有沙棘黄酮软胶囊、沙棘油软胶囊、清妍胶囊等六款保健品批号产品，在同类保健品中品质优良，技术含量高，受到广大消费者的好评。

公司先后通过了国家的食品出口卫生注册、ISO9001质量管理体系国际认证、HACCP食品安全体系国际认证、Kosher认证、欧盟、美国及日本的有机食品认证。产品加工过程从采果地认证 - 采果 - 分选 - 加工 - 包装 - 保鲜 - 储运等，各项工序严格遵照国际标准进行。开发生产系列沙棘产品，业务遍及中国和世界很多地区。

2019年，高原圣果沙棘制品有限公司被授予“国际沙棘协会企业委员会会长单位”。2021年，高原圣果沙棘制品有限公司荣获“国际沙棘协会优秀会员企业”称号。

国际沙棘协会（中国）企业委员会副会长单位 —— 北京宝得瑞健康产业有限公司

The introduction of Powdery

Beijing Powdery health industry company Ltd was founded in 1999, the company was mainly engaged in site management, deep processing of sea buckthorn and other agricultural products and academic research. After more than 20 years of development, it has become one of the leading enterprises of food ingredients processing in china. Currently , Powdery has two raw material sites, such as sea buckthorn and pumpkin, The area of wild sea buckthorn site was near 60 ten thousand Mu, which includes 10 ten thousand Mu of organic seabuckthorn site certificated by China ,Japan, EU and US. Powdery possesses four subsidiary corporations, distributed in Beijing, Hebei and Hubei, There are academician workstation and provincial engineering research center in the company, that support the company to own the leading manufacture processes and guarantee the quality of products.

Items of business:

The food ingredients: The oil,powder and juice of seabuckthorn ,pumpkin, linseed and asparagus etc.
Terminal products: Puree, beverages, solid drinks, candies and substitutional tea of sea buckthorn, pumpkin ,tea,asparagus. etc.
Business of ODM and OEM of products above mentioned.

宝得瑞介绍

北京宝得瑞健康产业有限公司成立于1999年，公司自成立以来一直致力于沙棘的基地管理、沙棘产品的深度加工与学术研究。历经20多年的发展公司发展为中国配料相关的龙头企业，目前公司拥有沙棘、南瓜两个原料基地其中野生沙棘基地60万亩，包含有机沙棘基地10万亩全部通过中国、日本、欧盟和美国的有机认证保证全链可追溯管理。公司拥有4个全资子公司分布在北京、河北、湖北等地，拥有院士工作站及省发改委工程研发中心，以行业领先的工艺制造平台为客户提供安全、安心、安定的产品保障。

经营项目

沙棘、南瓜、亚麻、芦笋系列粉类、油类、提取物类原料产品

沙棘、南瓜、茶叶、芦笋系列原浆类、饮料类、固体饮料类、糖果类、代用茶类终端产品

沙棘、南瓜、亚麻、芦笋系列 DEM/ODM 代工业务。

国际沙棘协会（中国）企业委员会副会长单位 —— 河北神兴沙棘研究院

Hebei Shenxing Seabuckthorn Research Institute, founded in 2000, located in Shijia-zhuang, capital of Hebei Province, which is a technology-based private enterprise dedicated itself in R&D of seabuckthorn series products. The company is engaged in the business of de-veloping seabuckthorn series products, technical services, health food processing and sales.

After more than 10 years of development, the institute has accumulated rich experience in the research fields of beverage, health food and medicine, and has a series of core technologies:

- 1.Super-critical CO₂ extraction,
- 2.Macro-porous adsorbent resin,
- 3.Membrane separation, etc.

we successively obtained 26 drug registration licences (there's one State Category?New Drug, 1 State Cat- egory?New Drug, 2 State Category ? New Drug) and 8 health food registration licences (soft capsule, tablet, oral liquid, raw materi-als cover seabuckthorn fruit oil, seabuckthorn seed oil, flavone, OPC, Puree, concentrated Juice, etc.), 1 certificate of invention patent for Seabuckthorn Wine. Besides, we also had more than 40 kinds of seabuckthorn scientific research reserve projects and made great records.

河北神兴沙棘研究院成立于 2000 年，位于河北省石家庄市，是一家以沙棘系列 产品研发为特色的科技型民营企业。主营业务为：沙棘系列产品开发、技术服务、保健食品加工及销售。

经过十几年的发展，研究院在饮料、保健食品、药品等研究领域积累了丰富的 经验，拥有了一系列核心技术：

- 1、超临界 CO₂ 萃取技术；
- 2、大孔树脂吸附技术；
- 3、膜分离技术。

先后取得 26 个药品批号，其中国家一类新药 1 个，国家二类新药 1 个，国家 6 类新药 2 个，沙棘系列保健食品批号 8 个（产品剂型丰富，涉及软胶囊、片剂、口服液，原料涵盖沙棘果油、沙棘籽油、黄酮、果粉、花青素、原浆、浓缩汁等），酒品专利 1 个，并拥有 40 多个沙棘科研储备项目，相关课题先后通过河北省重大科技攻关项目、自然科学基金及多个石家庄市级科研项目鉴定，取得了丰硕的学术成果。

国际沙棘协会（中国）企业委员会副会长单位 —— 吕梁野山坡食品有限责任公司

There are dozens of product categories which include seabuckthorn raw material, seabuckthorn con, Seabuckthorn beverage, seabuckthorn con, seabuckthorn seed, seabuckthorn fruit, seabuckthorn seed oil, seabuckthorn fruit oil, seabuck-thorn frozen dry fruit, seabuckthorn fruit dry skin, seabuckthorn dry fruit and seabuckthorn bis-cuit which are sold to places all over the country. The market share of terminal products main-tains 90% in north China. Seabuckthorn juicedrink, tinned seabuckthorn, seabuckthorn seed, seabuckthorn fruit, seabuckthorn seed oil, seabuckthorn fruit oil, dried seabuckthorn, dried sea-buckthorn skin and seabuckthorn dry fruit are exported to countries such as Japan, Korea and Germany. The sales ratio of products reaches 100%. The company buys more than 10,000 tons of seabuckthorn from farmers each year in the way of subscription agreement, which raises the income of more than 5,000 farming families with an average family income over 16,000 Yuan. Accordingly, the economic income of farmers in mountain area is improved and the development of rural economy is promoted.

BUSINESS CATEGORY

seabuckthorn beverage
seabuckthorn fruit oil
seabuckthorn dry fruit
seabuckthorn seed oil
seabuckthorn seed
seabuckthorn raw fruit
seabuckthorn oil capsule
abuckthorn fruit dry skin
seabuckthorn forzen dry fruit
seabuckthorn biscuit
seabuckthorn tea
seabuckthorn chewable tablets

主要产品有沙棘原料、沙棘口服液、沙棘饮料、沙棘罐头、沙棘籽、沙棘果肉、沙棘籽油、沙棘果油、沙棘干果、沙棘干果皮、沙棘果皮粉、沙棘饼干等几十个品种，产品销售网络遍布全国各地。终端产品在华北地区保持90%的市场覆盖率。沙棘原果汁、沙棘罐头、沙棘籽、沙棘果肉、沙棘籽油、沙棘果油、沙棘干果、沙棘干果皮、沙棘果皮粉等出口日本、韩国、德国等国家。产品销售率达到100%。公司每年以收购协议方式向农民收购沙棘10000吨以上，直接带动山区5000多名农民采收户，户均收入可达16000元以上。改善了山区农民的经济收入，促进了农村经济产业化发展。

经营类目

沙棘汁饮料 沙棘果油 沙棘干果 沙棘籽油 沙棘籽 沙棘原浆 沙棘油胶囊 沙棘干果皮 沙棘果皮粉 沙棘饼干 沙棘茶叶 沙棘咀嚼片。

国际沙棘协会（中国）企业委员会副会长单位 —— 内蒙古吉隆生态科技有限责任公司

Jilin Jilong Sea-buckthorn Co., LTD was established in 2017, based in Da'an City Jilin Province, the company is committed to developing the compound planting and processing of sea-buckthorn and Chinese medicine in the ecological fragile areas where it is difficult to plant such as land with saline-alkali soil and wind-blown sand. The company's mission is to promote the development of Chinese herbal medicine industry of Sea-buckthorn, and to achieve the purpose of rural revitalization and prosperity of the people through "integration of the three industries", that is, the close combination of ecological green economy and big health industry.

吉林吉隆东北沙棘产业有限责任公司成立于 2017 年，公司致力于以吉林省大安市为基地，在盐碱风沙等生态脆弱地带，发展大果沙棘和中药材复合种植与加工，通过生态绿色经济和大健康产业，实现“三产融合”全产业链紧密结合，促进沙棘中药材产业的发展，达到乡村振兴产业富民的目的。

With a total investment of 450 million yuan, the project includes planting 20 thousand mu of eco-economic forest of sea-buckthorn and 15 thousand mu of Chinese medicinal materials such as rhizome atrium, building processing and production bases of sea-buckthorn and Chinese medicinal materials, and promoting rural employment.

项目规划总投资 4.5 亿元，种植大果沙棘生态经济林 2 万亩和苍术等中药材 1.5 万亩，建设沙棘和中药材综合加工生产基地，带动农户种植大果沙棘和中药材 5 万亩。

After nearly 5 years of development, the company established strategic cooperation with Chongqing Taiji Joint Stock Co., LTD., Jizhong Pharmaceutical Co., LTD., Sinopremedy Group and other TCM enterprises to strengthen their supply chain of medicinal materials. In cooperation with Changchun University of Chinese Medicine, Jilin Agricultural University and other scientific research institutions, our research platform for Chinese medicinal materials planting has been rated as provincial leading enterprise of forestry industrialization, Jilin Provincial Demonstration Base of high-quality and Authentic Medicinal materials Science and Technology, Baicheng Demonstration Base of Chinese Medicinal Materials Planting, etc. The company is now the construction unit of Jilin Provincial Engineering and Technology Research Center, and the vice president unit of National Sea-buckthorn Entrepreneurs Association.

经过近 5 年的发展，已完成投资 1.52 亿元，与重庆太极股份公司、冀中药业、国药集团等中药企业建立战略合作，满足其中药材生产原料供应。与长春中医药大学、吉林农业大学等科研单位合作，共建中药材种植研究平台。被评为省级林业产业化龙头企业、吉林省优质地道药材科技示范基地、白城市中药材种植示范基地等，担任吉林省林业草原沙棘工程技术研究中心的建设单位，全国沙棘企业家协会副会长单位。

国际沙棘协会（中国）企业委员会副会长单位 —— 上海容邦企业集团有限公司

Shanghai Rongbang enterprise group co., LTD., founded in 2006, is a focus on health food and ecological industry development group company, Deep seabuckthorn industry 16 years, is committed to the seabuckthorn industry product production, technology research and development, brand marketing.

In 2007, Rongbang Group was awarded the "Member unit of the International seabuckthorn Association". In 2022, Rongbang Group was honored again and became an excellent member of the International Sea-buckthorn Association in 2022.

To promote the development of seabuckthorn industry, let state enterprise group was established in Australia in 2019, the asia-pacific seabuckthorn institute, it is a global professional organization of seabuckthorn research and technology development, docking global seabuckthorn frontier technology, gathered global seabuckthorn research technology, and focus on the seabuckthorn research and technology, into health products, service for all mankind.

上海容邦企业集团有限公司成立于2006年，是一家专注于健康食品领域和生态产业发展的集团化公司，深耕沙棘产业16年，致力于沙棘产业的产品生产、技术研发、品牌营销的全产业链打造。

2007年，容邦集团被授予“国际沙棘协会会员单位”。2022年，容邦集团再获殊荣，成为2022年国际沙棘协会优秀会员企业。

为推动沙棘产业的发展，容邦企业集团于2019年在澳洲成立了亚太沙棘研究院，它是全球沙棘研究与技术开发的专业性组织，对接全球沙棘前沿技术，聚集全球沙棘研究技术，并着力于将沙棘研究与技术，转化为健康类产品，为全人类服务。

Shangshengyuan seabuckthorn series products 上生源沙棘系列产品

沙棘籽油、沙棘果油 Seabuckthorn seed oil, seabuckthorn fruit oil	沙棘益生菌（肠/胃） Seabuckthorn Probiotics (Intestinal/Gastric)
沙棘原浆、沙棘枸杞原浆、沙棘果汁 Seabuckthorn pulp, seabuckthorn medlar pulp, seabuckthorn juice	沙棘水飞蓟 Seabuckthorn and Silybum marianum
沙棘洗发水（控油/滋养）、沙棘面膜、沙棘眼罩、沙棘护手霜、沙棘沐浴露 Sea Buckthorn Shampoo (Oil Control/Nourishing), Sea Buckthorn Mask, Sea Buckthorn Eye Mask, Seabuckthorn Hand Cream, Seabuckthorn Body Wash	沙棘冰酒 Seabuckthorn ice wine 沙棘黄酒、沙棘茶 Seabuckthorn yellow wine, seabuckthorn tea
沙棘木耳 Seabuckthorn and agaric	沙棘米醋 Seabuckthorn rice vinegar

国际沙棘协会（中国）企业委员会副会长单位 —— 陕西海天制药有限公司

Shaanxi Haitian Pharmaceutical Co., Ltd. is a high-tech enterprise integrating R & D, production and sales of medicine, Hippophae rhamnoides series health food, health care products and female beauty care products. It was established in 2001, headquartered in Xixian new area, Shaanxi Province, the existing drug production base of three, two seabuckthorn processing plants and 40,000 mu of seabuckthorn Chinese medicine planting base, more than 10 Chinese medicine formulation production lines, can produce more than 90 million boxes of Chinese medicine; The production line can process 6,000 tons of Chinese medicinal materials annually, and the equipment imported from Germany can produce more than 100 tons of sea buckthorn seed oil Supercritical fluid extraction year.

The company has more than 100 drug numbers, and its main products are Siji antiviral mixture (capsule), Mozhen capsule, compound seabuckthorn seed oil suppository, seabuckthorn dry emulsion, Baihe Gujin oral liquid and Xindakang tablets, etc., among them, there are 5 exclusive varieties, 4 patented varieties, 2 exclusive dosage forms, and 6 traditional Chinese medicine varieties with Hippophae rhamnoides as the main raw material. It is also the enterprise with the largest number of Hippophae rhamnoides as raw material in China, the annual demand of Hippophae rhamnoides is about 7000 tons. Enterprises has won more than 100 honours at various levels in China, the provinces and the municipalities.

陕西海天制药有限公司是一家集药品、沙棘系列健康食品、保健产品和女性美容护理用品研发、生产和销售于一体的高新技术企业，2001年成立，总部位于陕西省西咸新区，现有药品生产基地三处、两个沙棘加工厂和4万亩沙棘中药材种植基地，10余条中药剂型生产线，可年产中药成药9000多万盒；全自动化控制提取生产线可年处理各类中药材6000吨，德国原装进口的二氧化碳超临界萃取生产设备可年产沙棘籽油百余吨。

企业拥有药品文号100多个，主要产品有四季抗病毒合剂（胶囊）、蛾贞胶丸、复方沙棘籽油栓、沙棘干乳剂、百合固金口服液和心达康片等，其中独家品种5个，专利品种4个，独家剂型品种2个，以沙棘为主要原料的中药品种6个，也是国内拥有沙棘为原料药品文号最多的企业，年沙棘需求量约7000余吨。企业已荣获中、省、市各级荣誉100多项。

国际沙棘协会（中国）企业委员会副会长单位 —— 青海康普生物科技股份有限公司

General Health Group, established in May 2002, has been specialized in R&D in Characteristic plant resources from Tibetan Plateau such as Sea Buckthorn, Goji. We have focused on human nutrition and health business for over 20years, and have been identified by the government of National High-tech Enterprise, National Innovation-oriented Enterprise, National SRDI(specialized, refinement, differential, innovation)Little Giant Enterprise, National Key Leading Forestry Enterprise, National Key Leading Enterprise in Agriculture Industrialization, National Model Agro-processing Enterprise.

We have taken the lead in setting up the first leading academician workstation in the industry. Our R&D Center, established the cooperation of manufacturing and science between the enterprise and more than 20 top scientific research institutions, has been identified of National and Local Joint Engineering Laboratory.

We have got certificate of ACCP,ISO9001,ISO14001, ISO45001.We have got Chinese, EU, USDA,AND JAS Organic certification.We have got the CMA qualification certification.Full-chain traceability managementsystem has been ensured.High quality material has been ensured and provided by our organic plantation.Reliable products have been ensured and provided by our industry-leading manufacturing technique.

康普集团创立于 2002 年 5 月，从事青藏高原特色植物资源尤其是沙棘、枸杞的研究开发，专注于人类营养健康事业二十年的国家级高新技术企业、国家级创新型企业、国家级专精特新小巨人企业、国家林业重点龙头企业、农业产业化国家重点龙头企业、全国农产品加工示范基地。

率先成立行业首家院士工作站，研发中心被认定为“国家地方联合工程实验室”，与国内 20 多所顶级科研院所建立了产学研合作关系。

企业通过 HACCP/ISO9001/ISO14001/ISO45001 认证；中国、欧盟、美国、日本有机认证；CMA 资质认证；保证全链可追溯管理。有机基地确保优质原料，行业领先的生产工艺平台为您提供放心产品。

国际沙棘协会（中国）企业委员会副会长单位 —— 新疆康元生物科技股份有限公司

Xinjiang Kangyuan Biotechnology Group Co., LTD., founded in June 2009, has a registered capital of 61.2 million yuan and total assets of 180 million yuan. Registered in Xinjiang Habahe Industrial Park, it is a joint-stock enterprise integrating the cultivation, research and development, deep processing and sales of small berries with big fruit sea-buckthorn as the main. It has a senior management team composed of famous experts from investment bank, forest fruit, sea buckthorn and other industries. The group has become a national high-tech enterprise, a leading enterprise in Xinjiang's key agricultural industrialization, a leading enterprise in Xinjiang's key poverty alleviation, a small giant enterprise in Xinjiang, and one of hundreds of companies to be listed in Xinjiang's key cultivation.

The Group's own demonstration planting base of sea-buckthorn has obtained the organic certification of China, the European Union and the United States and the record of export base of Xinjiang Inspection and Quarantine Bureau. It has also passed the certification of HACCP, ISO22000 food safety management and ISO9001:2015 quality management system.

The company is the world's first manufacturer of vacuum freezing and low-temperature drying technology, and has launched the concept and series products of sea-buckthorn whole fruit powder, sea-buckthorn fruit pulp powder, sea-buckthorn mixed functional fruit powder, Wolfberry whole fruit powder, sea-buckthorn original pulp, sea-buckthorn juice, sea-buckthorn milk beverage and sea-buckthorn whole fruit oil, creating a unique sea-buckthorn big fruit industry chain.

新疆康元生物技术集团股份有限公司，始建于2009年6月，集团注册资金6120万元，总资产1.8亿元。注册地为新疆哈巴河工业园区，是集以大果沙棘为主的小浆果种植、研发、深加工、销售为一体的股份制企业，拥有来自于投行、林果、沙棘等行业内著名专家组成的高层管理团队。集团现已成为国家级高新技术企业、新疆重点农业产业化龙头企业、新疆重点扶贫龙头企业、新疆专精特新小巨人企业，新疆重点培育百家拟上市公司之一。

集团自有的大果沙棘示范种植基地，获得了中国、欧盟、美国有机认证和新疆检验检疫局的出口基地备案，也通过了HACCP、ISO22000食品安全管理、ISO9001:2015质量管理体系认证。

全球首创真空冷冻、低温干燥技术，首发沙棘全果粉、沙棘果浆粉、沙棘复配功能果粉、枸杞全果粉、沙棘原浆、沙棘原汁、沙棘乳饮料、沙棘全果油概念及系列产品，打造独一无二的大果沙棘产业链。