GLOBAL TRENDS IN MULBERRY AND SILKWORM USE FOR NON – TEXTILE PURPOSES

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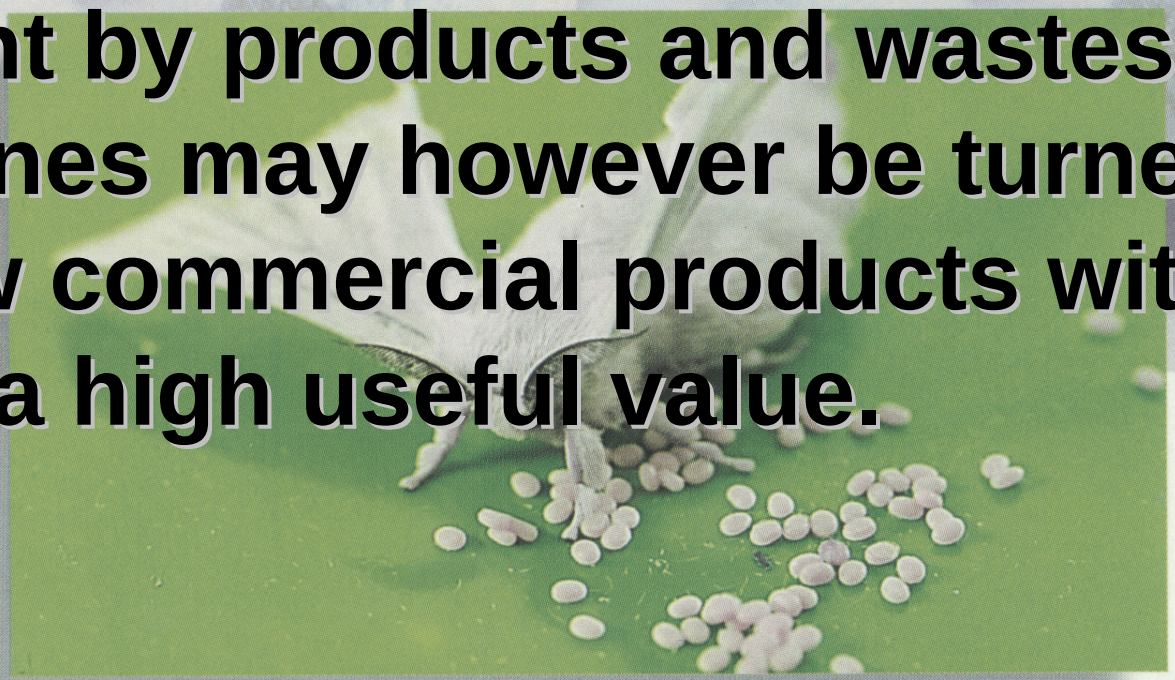
Introduction

The sericulture involves a large scale of interdependent technologies from which results different by products and wastes. These ones may however be turned into new commercial products with a high useful value.



Since the silkworms rearing activity is decreasing at international and national level, it was necessary a diversification of exploitation methods for mulberry plantations and silkworm production. Through silk production projects, mulberry has been taken to countries all over the world. Although the majority of silk production projects have had limited duration because of silk processing constraints and limited market opportunities, mulberry trees have remained in most places where they have been introduced. With the recent decline of sericulture industry, mulberry has been re-evaluated for other purposes, such as medicinal, fruit and animal production.




Sericulture implies significant quantities of secondary and waste products. In order to ensure a profitable sericulture activity, it is necessary to process these secondary and waste products in order to obtain biologically active substances with important uses in pharmaceutical, cosmetic, paper and cellulose, and organic agricultural food industries. By applying, some modern methods for processing the secondary and waste products from sericulture, additional incomes that will even double or triple the incomes obtained from the main activity will be created.

Introduction

In Bulgaria the research team of Sericulture Experiment Station, Vratza has made detailed research work on the identification and evaluation of the silkworm rearing waste products. It was estimated that the silk production performs only 8.54 % from the dry matter mulberry leaf yield obtained by one hectare plantation. On the other hand the different wastes such as leaf remnants, excrements and the pupae give 2061.60 kg of dry matter or 83 %.

Introduction

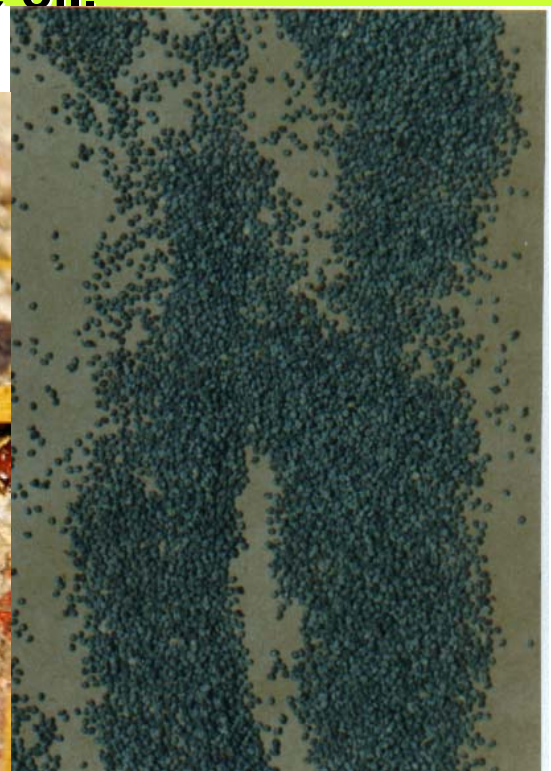
It was detected that the nitrogen percentage in the compost, prepared by silkworm rearing wastes is 1.68 %, or similar to those obtained from the caw dung.

There have been put the beginning of using the mulberry for phytoremediation of heavy metal polluted soils. It was detected that regardless the high contents of lead and zinc estimated in the mulberry leaves, excrements and silkworm body as a whole the contents of heavy metals in the cocoon shells and silk were negligible. Therefore it is concluded that the mulberry – silkworm producing system could be used as a biological method of cleaning and utilization of heavy metal polluted soils.

A project for the possibilities for using mulberry fruits has also been initiated recently at the SES - Vratza. Other direction of mulberry using in Bulgaria recently became for production of high quality wood for the furniture industry.

Introduction

In Romania, there are nowadays, scientifically research activities concerning development of a profitable way of sericulture waste and by products utilizing. As a result of interdisciplinary collaboration between different companies and national research institutes, there were obtained new commercial products for the local and international market such as embryonic extract from silkworm eggs and cosmetic cream with pupae oil.



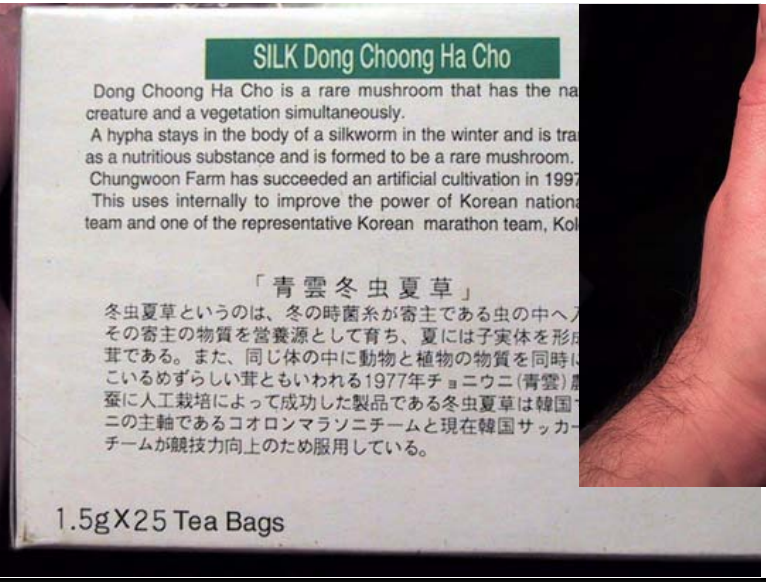
Introduction

During 1990 – 2008, C.S. SERICAROM obtained three patents, namely for “Biomorus” which is a stimulating composition with antidiabetic function, for “Humanofort B” - it is a natural biostimulator, having a catabolizing and rebalancing effect of the endocrine functions on the consumer and for “Mulberry dried fruits powder - obtaining procedure and its utilization”. It is a natural raw material for sweet products industry.

Five research and development projects were financed by the Romanian Ministry of Education and Research, in the frame of National Research Programs, having as purpose the experimental exploratory testing concerning the obtaining of bioproducts from sericulture waste.

Thanks to the Ministries of Sciences of Romania and Bulgaria, which approved the contract bilateral project "Application of modern methods for processing the products and sweepings resulted from sericulture in order to obtain new ecological agriculture food" for a period of two years, between the partners Institute of Bioengineering, Biotechnology and Environmental Protection – S.C. BIOING S.A. - Bucharest, Romania and the Sericulture Experiment Station-Vratza - Bulgaria, there will be developed scientific research activities in obtaining of new bioproducts from sericultural wastes.

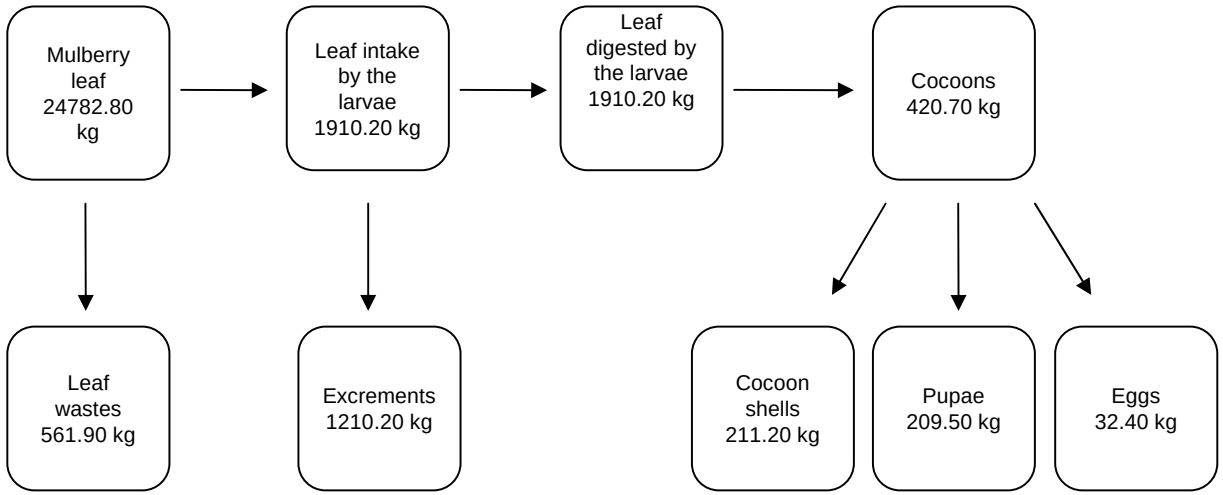
MATERIALS AND METHODS



The paper was developed by a visual plot for utilization of non-textile products and wastes resulted from sericulture. According to this visual plot, experimental researches from over 150 scientific papers were studied, analyzed and presented in this paper.

As a first step in this study, it was made the identification and evaluation of the silkworm rearing waste products.

The data reveal that the dry matter balance from one ha mulberry plantation was as follows:



The global trends in mulberry and silkworm use for non-textile purposes relieve the following aspects concerning the sericulture bioresources:

I. BOMBYX MORI L.

Silkworm eggs

They are used as male sexual stimulator (in popular tradition), as extract, rich in proteins, with energizing and hepatic protector action, hypolipidic and hypoglycemic effect. In Bulgaria some people believe that the silkworm eggs, if eaten by heavy alcohol drinkers then they give up drinking completely because start feeling alcohol disgust. However this fact has not been proved scientifically yet.

BOMBYX MORI L.

Silkworm larvae

They are used for feeding young animals, reptiles, as proteic flour having the role of dietary supplement; also as etheric extract having a high bombycisterol (a cholesterol isomer) content. In the developed countries the silkworm larvae are used for educational purposes and also in the live museums.

BOMBYX MORI L.

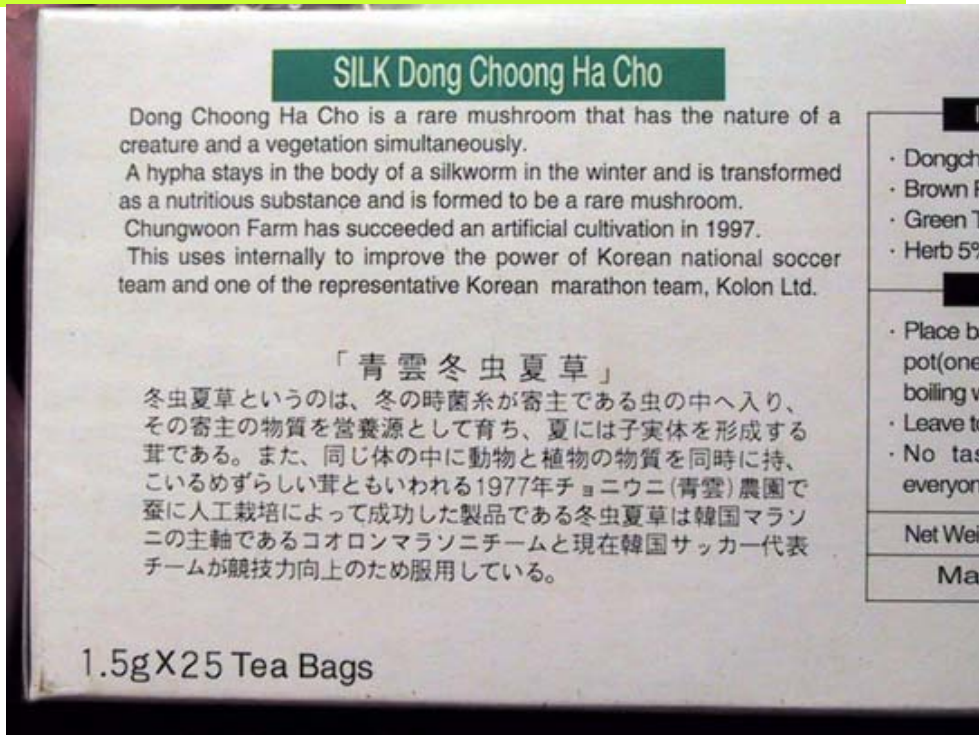
Silkworm larvae

Traditionally, silkworm has been utilized as a diabetic medicine in the oriental countries such as China, Korea, and Japan, and recently many researches have proved the blood glucose-lowering effect of the silkworm. A recent research result (Ryu et al., 2005) showed that the maximum blood-glucose lowering effect of the silkworm can be obtained when the silkworm was prepared at the 3rd day of fifth instar, manufactured by freezing dry method, and taken in the form of powder. In the experiment intended for diabetic patients, the most optimizing result was obtained in the dose of 900mg per day, during meal rather than after meal.

BOMBYX MORI L.

Silkworm larvae

Recently (Sung, 2002), lots of new techniques to produce a new sericulture products such as Genus *Cordyceps* of entomopathgenic fungi, silkworm powder for lowering blood sugar and Nuegra, a natural alternative to Viagra by using silkworm, have been developed in Korea to overcome the declining industry and the mulberry plantation has now revived to the increasing cultivation.



BOMBYX MORI L.

Pupae

They result form the cocoon reeling process and contain: 50-60% proteins, 25 – 35% fats, 8 – 10% sugars, E, B1, B2 vitamins, nicotinic acid, pantothenic acid, calcium, phosphorous, copper, iron and selenium.
In the Asian countries the pupae are appreciated as a tasty food.

BOMBYX MORI L.

Pupae

From the pupae, the following products are obtained:
Pupae oil, used in the pharmaceutical industry. From the same chrysalis oil, superior sodium and potassium soaps are obtained; varnishes and dyes used in the textile industry are also obtained.
In Romania, the chrysalis oil is produced by SC. Biotehnos SA, Bucharest.

BOMBYX MORI L.

Pupae

The residue formed during the chrysalis oil's extraction is used as natural organic fertilizer and as food for poultry, pigs, fish and fur bearer animals.
The silkworm pupae due to their high fat content (over 30%), are used as chrysalis oil to obtain cosmetic products (cream, soap, lotion, emulsion) and as proteic powder for valuable animal's fodder.

BOMBYX MORI L.

Moth

They are used to prepare pharmaceutical products for trauma and convalescence recovery, or to strengthen the masculine functions. The silkworm moth oil can be used to obtain textile dyes and superior soaps. The extraction residue can be used in obtaining of monosodium glutamate or as fodder. The butterflies can also yield Cellular Cytochrome C for pharmaceutical use, uric acid or hormones and sex messengers of the PTTH (hormone of central nervous system) and DH type (sexual hormone).

BOMBYX MORI L.

Sub-products from silk manufacture

From these, there can be obtained:
- wool and thread of camel hair type (spun silk)
- silk powder for cosmetic products or for pharmacological amino-acids
- silk waste water from the reeling mill, containing soluble silk (sericine).
- proteic gels;
- proteic precipitates with inorganic salts;
- microfibers;
- atomized proteic powders;
- lyophilizated proteic powders;
- proteic agents used for textiles and leathers' finishing;
- hydrolyzed silk protein

The remaining materials from silkworm rearing are of the following types:

excreta, containing: 7.35% water, 13.88% crude protein, 1.44% raw fats, 15.41% raw cellulose, 47.15% substances without nitrogen.

They can be used as organic fertilizer, as chlorophyll source (by alcoholic extraction) or as drug for heart diseases in the traditional Chinese medicine.

Residuum of silkworm rearing composed of vegetable mulberry remnants and excreta, that can be used as organic fertilizer, as compost or fodder for animals during winter (silage) for feeding sheep, goats, buffalos and caws.

II. MORUS sp.

The main use of mulberry globally is as feed for the silkworm but, depending on the location, it is also appreciated for its fruit (consumed fresh, in juice, alcoholic drink or as preserves), as a delicious vegetable (young leaves and stems), for its medicinal properties as mulberry leaf tea, for afforestation, decoration and as animal feed etc.

There were made researches regarding mulberry plants utilization for phytoregenerable activity such as environment polluted with traffic lead decontamination, phytopharmaceutical - obtaining therapeutic products from mulberry roots, fruits and leaves, agroalimentary production - semi-finished sugar product from mulberry fruit and proteic concentrate out of mulberry leaves. Lately, it was evaluated the economical potential of Morus plants as regenerable energy source, for an intensive cultivation system. Studies have been recently conducted on the characterization of mulberry leaves for biogas.

Mulberry leaves are used fresh or dried, as antidiabetic tea and to obtain diverse food products such as sweet products, bread, refreshment juices.

II.1. MORUS sp. Leaves

There are many countries where mulberry is utilized traditionally as a feed in mixed forage diets for ruminants, such as in certain areas of India, China, Afghanistan, Bulgaria, Georgia, Azerbaijan etc. However it is surprising that a plant that has been improved for leaf quality and yield to feed the silkworm, which has high nutritional feed value, has received such limited attention from livestock producers, technicians and researchers.

II.1. MORUS sp. Leaves

Even though there have not been conducted any systematic researches on the use of mulberry leaves for the domestic animals feeding in Bulgaria it is very common in the rural areas that the farmers use the leaves and shoots of mulberry trees for feeding sheep, goats, caws, rabbits etc. Mulberry leaves can also be used in poultry rations. Incorporation of shade-dried mulberry leaves in layers' mash to the extent of 6 percent showed an increase in egg production with desirable yolk colour without any adverse effect on body weight and egg quality. It was proved scientifically that the mulberry leaves could be advantageously incorporated in the diets of Angora rabbits for wool production.

II.1. MORUS sp. Leaves

The use of high protein mulberry tree fodder should be encouraged to provide supplementation of crop residues and natural pastures, thereby increasing productivity and the overall use of available on-farm biomass. There is a need for systematic research on the optimization of the use of this tree forage and for developing strategies for its optimum supplementation under different feeding situations. It is also an attractive option to achieve an integration of silk production and livestock rearing.

II.1. MORUS sp. Leaves

Systematic studies are necessary in order to know the mulberry superior genotypes, collect and maintain germplasm, and conduct agronomy and management studies. Such studies include: environmental adaptation; establishment and propagation; defoliation management of trees; planting density, cutting intervals and cutting heights in intensive forage production systems. This will improve biomass production with high nutrients for livestock feeding and extend the ecological range of the plant. The future role and value of mulberry will depend on the outcome of these programs.

II.2. MORUS sp. Fruits

Mulberry fruits are used fresh, dried or frozen in the food industry to obtain different syrups, wine, vinegar and different sweet products like marmalade, chocolate, frosting, jelly, oil from mulberry seeds. Mulberry fruit juice it is also used as natural alcoholic extract additive for food and pharmaceutical industries. From the mulberry fruits after alcoholic fermentation and further distillation it is made a perfect hard alcoholic drink.

II.3. MORUS sp. Roots

Mulberry root biomass is a valuable raw material for the pharmaceutical industry, due to its high flavones and phenol content. It is also used in the food industry for natural coloring.

Mulberry root bark is used in traditional medicine, especially in Asian regions. Modern medicine has confirmed the therapeutic potential of the products obtained from *Morus sp.* root bark, products which have a specific pharmaceutical activity of some fractions obtained from mulberry root bark.

II.4. MORUS sp. – twig branches and wood stem

They are used in cosmetics – for hair lotions; moisture products for skin, in the paper industry, in the wood processing – for furniture, as fuel, in the food industry – for natural coloring, alcohol ennobling and in the textile industry – for making the so called “artificial cotton”.

II.5. MORUS sp. – phyto remediation

The development of moriculture as an ecological and biological method for soil cleaning as well as for afforestation shall be an important approach for the sericulture re-launch.

MAJOR CONSTRAINTS AGAINST AND RECOMMENDATIONS FOR PROMOTION OF USING THE SERICULTURE PRODUCTS FOR NON –TEXTILE PURPOSES IN THE BALKAN COUNTRIES

- **Lack of tradition and experience in the scientifically based processing the waste and by – products from sericulture;**
- **Not sufficient research made on the subject;**
- **Lack of enough industrial technologies for sericulture products non-textile processing;**
- **There is an urgent need for sericulture product diversification to meet the demands on the international market;**

MAJOR CONSTRAINTS AGAINST AND RECOMMENDATIONS FOR PROMOTION OF USING THE SERICULTURE PRODUCTS FOR NON –TEXTILE PURPOSES IN THE BALKAN COUNTRIES

- **The present European system for giving subsidies to the sericultural farmers requires producing obligatory not less than 20 kg of fresh cocoons from one box of eggs. In the case that the farmers sell for example silkworm larvae instead of cocoons they can not get any EU subsidy. Therefore there should be found some other criteria to prove the amount of silkworms reared and the EU regulations for the subsidies to be changed in order to stimulate not only the cocoon production but the other products from sericulture as well.**

MAJOR CONSTRAINTS AGAINST AND RECOMMENDATIONS FOR PROMOTION OF USING THE SERICULTURE PRODUCTS FOR NON –TEXTILE PURPOSES IN THE BALKAN COUNTRIES

- **The mulberry and silkworm breeding priorities may be re-directed in order to meet the requirements of the products use for non – textile purposes. For example some new mulberry varieties with high fruit yield and quality or varieties with faster growth and accumulation of quality wood for the furniture industry may be created.**

In the silkworm new strains having bigger larvae and pupae or with higher sericin content or tolerable to artificial diet feeding or breeds with some specific quantitative traits may be evolved.

MAJOR CONSTRAINTS AGAINST AND RECOMMENDATIONS FOR PROMOTION OF USING THE SERICULTURE PRODUCTS FOR NON –TEXTILE PURPOSES IN THE BALKAN COUNTRIES

- **It is also important to develop a technology for production and supply with high quality silkworm eggs all over the year.**
- **It is necessary that the mulberry agrotechnics and harvesting systems and the silkworm rearing technologies to correspond with those new non – textile purposes product use.**

MAJOR CONSTRAINTS AGAINST AND RECOMMENDATIONS FOR PROMOTION OF USING THE SERICULTURE PRODUCTS FOR NON –TEXTILE PURPOSES IN THE BALKAN COUNTRIES

- **The silkworms use for non textile items requires in many cases to grow them all over the year, therefore the Balkan countries have to develop the silkworm artificial diet rearing system.**

MAJOR CONSTRAINTS AGAINST AND RECOMMENDATIONS FOR PROMOTION OF USING THE SERICULTURE PRODUCTS FOR NON –TEXTILE PURPOSES IN THE BALKAN COUNTRIES

- **The producers should identify long-term strategic policies, technology development, and innovations, considering the importance of the factors involved such as product standard, production technology, technology development, and product innovation.**

- **It is expected that production costs in the Balkan region will increase while more countries with lower labour costs will join the sericulture production. Therefore, it is challenged to the region producers to compete in the world markets. In order to survive in sericulture business, producers should not make cheap products with low quality to compete for the prices but to produce more sophisticated products which satisfy consumers even though they are more expensive.**

MAJOR CONSTRAINTS AGAINST AND RECOMMENDATIONS FOR PROMOTION OF USING THE SERICULTURE PRODUCTS FOR NON –TEXTILE PURPOSES IN THE BALKAN COUNTRIES

The strategy of Balkan region sericulture products processing industries should be to produce our own unique products which are definitely different from other countries.

It is important to encourage the sericulture products processing companies to establish global relationships, such as international joint ventures and cooperative deals in the field of research and technology licensing.

MAJOR CONSTRAINTS AGAINST AND RECOMMENDATIONS FOR PROMOTION OF USING THE SERICULTURE PRODUCTS FOR NON –TEXTILE PURPOSES IN THE BALKAN COUNTRIES

- **The producers should establish a network to make collaboration among different sectors of supply chain at the regional level. The different sectors, which include all stakeholders in sericulture products processing industry from downstream to upstream of supply chain, may be formed into a cluster according to the local which they are. The cluster system can reduce and eliminate the problem of producers by supporting each other in term of raw material, technology, equipment and marketing. So this system is more efficient in term of cost reduction, quality improvement and quick responding to consumers' needs.**

- **And final but very important is also to promote the sericulture products as natural and environmental friendly.**

CONCLUSIONS

1. Proper utilization of secondary and waste products of sericultural industry can generate extra income in addition to the silk, the main output. The major wastes and by products of sericulture are sericin, pupae, moths, silkworm excreta, silk fiber waste and mulberry leaves, fruits and roots. The new commercial products have been obtaining from these raw materials with the valuable destination for pharmaceutically (anti diabetic, antiviral, hypoglycemic, antibacterial and antivirus products), cosmetically (skin and hair products), zootechnically (fodder for caws, rabbits, goats, poultry, pigs, sheep and fur animals), foodstuff (oil, juice, marmalade, wine, fruit distillate, vinegar, dried fruit powder, natural coloring) and ecological use (afforestation, phytoremediation).

CONCLUSIONS

2. Considering the high potential of using the sericulture products for non – textile purposes the research institutions in the Balkan countries should pay more attention in doing research in this field in order to create new valuable items, utilizing the available mulberry and silkworm germplasm resources, mulberry plantations and silkworm rearing infrastructures.

CONCLUSIONS

3. The development of sericultural products use for non – textile purposes direction may be considered as an alternative way to solve partly the problem with the decline of silk production and the efficient utilization of the existing sericultural human capacity, research and production facilities.

CONCLUSIONS

4. It seems to be difficult and costly for new entrants to build such a large amount of know-how in relatively short periods of time. Therefore, these problems may be eliminated by regional collaboration or network establishment. Hence, domestic, regional and international cooperation can help in sharing information on research and technologies.

CONCLUSIONS

5. It is necessary to establish an international working group on the sericultural products use for non – textile purposes which may include countries new comers, comparatively more developed, developing, advantage, producer, consumer and trader, to discuss, identify, and analyze major constraints and strategies for development in global aspect. This group may include experts in all areas and fields both from the private and governmental sectors.

CONCLUSIONS

6. As a follow up of the present first Balkan workshop on “Possibilities for Using Silkworm and Mulberry for Non-Textile Purposes” a regional working group on the sericultural products use for non – textile purposes may be established, including members from all Balkan states.


Thank you for
your attention