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SCIENTIFIC ADVANCES IN UKRAINE AND WORLD EXPERIENCE OF CREATING INNOVATIVE PRODUCTS MADE FROM OILSEED FLAX STRAW
/
НАУЧНЫЕ ДОСТИЖЕНИЯ В УКРАИНЕ И МИРОВОЙ ОПЫТ СОЗДАНИЯ ИННОВАЦИОННОЙ ПРОДУКЦИИ С СОЛОМЫ ЛЬНА МАСЛИЧНОГО

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ABSTRACT

World practice of flax straw burning goes back to generations and oilseed flax is regarded not only as a seed production crop, but also as a cost-effective supplementary textile raw material. In Ukraine, oilseed flax is the only domestic raw material, which can be an alternative to imported cotton and fibre flax for use in the textile, pulp and paper industries and the production of reinforced composite materials.

The article presents scientific and practical achievements in creating innovative products based on oilseed flax straw, both in Ukraine and abroad.

The analysis of standardization of straw and oilseed flax products indicates the absence of regulations determining their quality, the development of such regulations being a crucial issue. At present, there is no clear classification of fibres and physical and mechanical properties that would characterize the scope of their industrial application.

РЕЗЮМЕ

В мире. практика сжигания соломы льна масличного уходит в прошлое и его рассматривают не только. как культуру для получения семян. но и как экономически эффективное дополнительное текстильное сырье. В Украине. лён масличный - это единственный отечественный сырьевой ресурс. который может стать альтернативой импортному хлопку и льну-долгунцу для использования в текстильной. целлюлозно-бумажной промышленностях и производства армированных композиционных материалов.

В статье представлены научные и практические достижения в создании инновационной продукции на основе соломы льна масличного. как в Украине. так и в мире в целом.

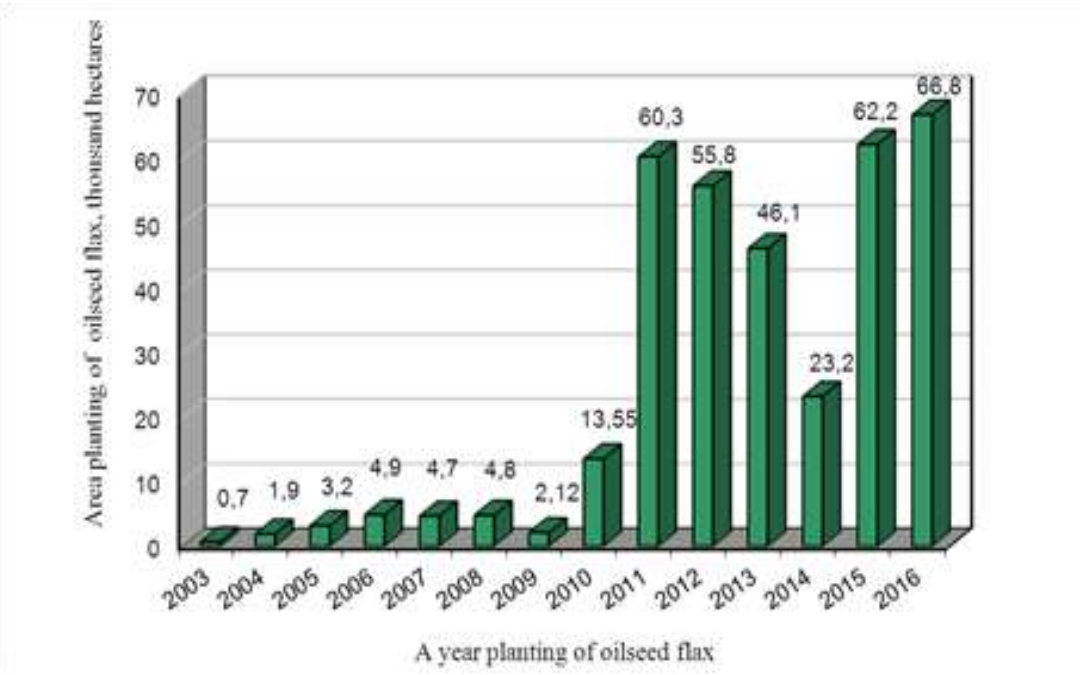
Анализ состояния стандартизации соломы и продукции со льна масличного. свидетельствует. об отсутствии нормативных документов для определения их качества. разработка которых является актуальным вопросом. В настоящее время не существует четкой классификации волокон и физико-механических показателей. которые бы характеризовали сферу их промышленного применения.
для текстильной промышленности.

INTRODUCTION

Oilseed flax, Linum Usitatissimum L is a valuable commercial crop of the Linum genus and the Linaceae family. It is considered that the main advantage of oilseed flax is production of seeds which have medicinal, bactericidal and antioxygenic properties. Therefore, seeds are widely used in food, formula-feed, pharmaceutical and chemical industries. The oil received from seeds can be used as raw material for the technical purposes in the paint and varnish, soap-producing and tanning industries, as well as in typographical production, production of aluminum and oil paints for painting and in many other areas [The story of flax. 1997].

In Ukraine, until recently, farmers have massively ignored oilseed flax, fearing further problems with the sale of seeds. However, the successful marketing of the oilseed at high prices in the world dramatically changed the situation [Business Publications. 2015].

In recent years, in Ukraine, according to the data of the State Statistics Committee of Ukraine [State Statistics Service of Ukraine, 2016], the structure of sown areas of oilseed flax has substantially changed (fig,1). The main areas are concentrated in Dnieper, Zaporizhya, Mykolayiv and Sumy regions. At the same time, active participants in the oilseed flax market became "Agricultural enterprise" Zaria "(Zhytomyr region), the enterprises of production and commercial firm" Siaivo "(Chernihiv region), state enterprise" Experimental farm "Askaniiske", Institute of irrigated agriculture of the southern region NAANU (Kherson region,) (*Business Publications, 2015*).



Fig, 1 - Dynamics of cropped areas of oilseed flax grown in the territory of Ukraine from 2003 to 2016

At the same time, there is no practical application of oilseed flax straw in Ukraine. After collecting seeds by combine harvesters in the fields, the straw remains and is then burned. If earlier in case of small areas of crops, straw was burned and it did not cause disturbance of ecological security, today, it cannot do without penalty. So, in 2016, with yield of 2 tons of straw per hectare, 136, 600 tons of oilseed flax straw were burned. This issue appears on the agenda at the farmers and this concerns not only Ukraine.

MATERIAL AND METHOD

According to the analysts of Oil World, the largest cropped areas of oilseed flax are concentrated in Canada (about 2 million hectares), Argentina (101 thousand hectares), China (570 thousand hectares), India (930 thousand hectares), Great Britain (101 thousand hectares), the USA (135.17 thousand hectares), Germany (110.048 thousand hectares). Such countries as Finland, Poland, France, Belgium and Belarus (2.5 thousand hectares) have begun to cultivate this crop recently (*Saskatchewan Flax Development Commission, 2015)*.

The government of Canada which is the leading country in the world by the number of acreage of oilseed flax is also puzzled with a subject of burning straw. One can only imagine what ecological damage will be caused to the environment if about two million hectares are burned annually. Farmers, in the 1990s called this phenomenon "the intended large-scale fires". Speaking at the symposium, they appealed to the state bodies of this country to create the market of oilseed flax straw of flax as of an additional source of textile fibre. (*Comeau G, 2006; Heuzé V, Tran G, Lebas F, 2015*).

Today, on the basis of conducted research and development activities in Canada, 6 firms were created for processing flax straw (laxStalk / SWM, Biolin, Stemia, Vegreville Decortication, Crailar Flax, and Stemergy), 14 firms for processing flax fibre and and three companies for the production of bio-energy products, that are concentrated in Western Canada, North Dakota, and North America,.

This industrial complex manufactures multifunction products of "new generation" from oilseed flax straw: household textile materials (In Alberta, processing firms are located in the Lethbridge), filter paper (company Delstar) and cigarette paper (SWM (Schweitzer Mauduit International, Canadian flax straw processor is FlaxStalk which is located in Manitoba), composite and non-woven fabrics, industrial geotextile, biofuel and others.

Fuel, chemical, food and beverage, pulp and paper companies are increasingly finding advantageous uses of biotechnology in their production processes. The company CIC has developed a composite that will be used for the the next generation hood of Buhler tractors. National program Flax Canada 2015 has developed a strategic plan on research and development, commercialization and branding of products based on oilseed flax due to full utilization of the plant.

These products are manufactured and sold only for the domestic market on a small scale since the global marketing of innovative products is only possible upon condition of availability of documents regulating quality. To solve this problem, the FibreCity was created (part of Composite Innovation Centre) which is developing quality standards and grades of natural fibres. This will allow to potential users to know what they are getting and how the fibre can be used (*Dr, Shelley Thompson, 2015*).

In China, at high-level of scientific research, experiments are carried out on microscopic fibres derived from flax straw, with the aim of producing "know-how" products. Namely, it is the creation of bicomponent fibres by means of thermal bonding for creating innovative nonwoven and composite materials and technical textiles (*Kulmaa ., 2015; Krzysztof H, 2015; William A, 2007; Hegde G.S, 2011; Sikkema M., 2003*),

Agricultural Research Centre of Finland presented a report on the scientific advances in the study of the properties and processing of oilseed flax straw and monoecious non-narcotic hemp for producing high-quality fibres of various industrial uses: decorative and household textiles, technical textiles, agro-fibre composite materials, paper of special and technical use, insulation materials, wood-fibre boards. At the moment, their research is focused on evaluating the quality of oilseed flax fibres and establishing classification system that would characterize their scope (*Sankari ., 2000*).

In Russia, oilseed flax is also cultivated, particularly in Altai Krai and Bashkortostan. Structures of industrial use of flax straw are just beginning to develop, so the practice of burning straw in the fields still exist. But farmers already understand that flax straw is a valuable raw material, from which you can obtain textile low cost cellulose fibre and sell it at a reasonable price. Entities interested in the processing of flax straw are usually mostly non traditional flax-scutching mills but small private enterprises cooperating with research centers (All-Russian Research Institute of mechanization of flax cultivation VNIIML). Scientists of Kostroma State University are engaged in development of resource-saving technologies for processing oilseed flax straw in order to obtain fibre of a wide industrial application and assess its quality (*Uschapovsky, I. V., 2009*).

In Ukraine, the scientists of the Department of commodity science, standardization and certification of Kherson National Technical University (KNTU), under the supervision of Doctor of Science, professor, head of the department L,A, Chursina, have carried out a thorough research. For processing of oilseed flax retted straw, in order to obtain fibres of different functional purpose, experts of KNTU developed a new resource-saving technology requiring renovating existing production equipment,.

According to the results of experimental and theoretical research in the laboratory and production environment samples of innovative products from this flax straw were obtained. Namely, the mixed yarn: oilseed flax-cotton, oilseed flax- polyethyleneterephthalate (lavsan), oilseed flax-wool (LLC "Boguslaw Textile", Kiev region), composites (SE "Plastmass" LLC "TD Plastmass-Priluki" Chernihiv region) semi-finished cellulose materials, filter paper (LLP "Tsyurupinsk pulp and paper mill", Kherson region,) and non-woven fabrics (JSC "Flax processing mill Starosamborskyi» Lviv region,) (*Tihosova, GA. 2011*).

This product is of great economic importance, environmentally friendly, meets modern consumer needs of the population, can compete with imported products, but above all we have domestic raw materials for its production.

As it is known, nowadays the light industry of Ukraine is in economic crisis, and one of the main reasons is its dependence on imported raw materials. Therefore, oilseed flax is the only domestic raw material, which is able to fully replace imported cotton and fibre flax for the textile industry, thereby ensuring a strategic and financial independence of our state.

For moving these innovative products beyond laboratory research, its large-scale production and sales in the domestic and global markets, it is necessary to develop and adopt national regulations to assess the quality of the straw, fibres and products from this group of flax.

Since Ukraine has no standards for conducting trade analysis of stems, retted straw, and innovative products from oilseed flax, existing standards on fibre flax and cotton were used, the vast majority of which were created in Soviet times.

Oilseed flax straw and retted straw were evaluated according such physical and mechanical properties: moisture, content of bast (fibre), handful length, diameter and color of stems, maturing degree, separability of fibres from wood, mass content of shives and the breaking load were determined by instrumental method according to the standards GOST 28285-89 и DSTU 4149: 2003 [GOST 28285-89, 1990; DSTU 4149: 2003, 2003].

The main quality indicators of oilseed flax fibres, which were determined during the experiments according to DSTU 5015: 2008 and TU.U.05495816.005 - 2000 were the following parameters: strength, shives and impurity content, flexibility, linear density, average mass and length of fibres and their irregularity [DSTU 5015: 2008, 2008; TU.U.05495816.005 – 2000, 2000].

But the results of studies of physical and mechanical properties of stems and fibres, their morphological and anatomical structure show a significant difference of qualitative characteristics from flax and cotton [Golovenko T.N., 2016].

Furthermore, the given characteristics of straw and oilseed flax fibres depend not only on the parameters and modes of processing, but also on the climatic conditions of cultivation, carried out agricultural activities and seed collection methods [Ferguson G., 2009; Jonn A. (2009)], a change which can significantly affect the quality indicators of finished products.

Therefore, vitally important and acute issues today for Ukraine are as follows:

- developing standards for evaluating the quality of straw, fibres and innovative products from oilseed flax;
- creating classification of fibres according to physical and mechanical characteristics, which will determine their functional purpose;
- determining complex and integral indicators of the quality of innovative products from oilseed flax;
- developing technology of the expert examination of innovative products from oilseed flax;
- determining dependence of the qualitative characteristics of fibres on growing conditions, harvesting techniques and mechanical processing of oilseed flax straw.

CONCLUSIONS

As world practice shows oilseed flax is an annually renewable “biological raw material” of new generation.

Organization of the industrial complex for processing oilseed flax straw in Ukraine will provide domestic textile enterprises with cellulose-containing raw material, which is of strategic importance, in conditions of complete import dependence of our country.

Taking into account the world experience, the scientists of Kherson National Technical University developed the technology of oilseed flax straw processing to produce fibres of different functional purpose. As a result of research work carried out in the laboratory and in industrial conditions, innovative product samples have been created from fibres of this group of flax: blended yarn, composite materials, semi-finished cellulose materials, filter paper and nonwovens.

However, large-scale manufacturing of innovative products for the purpose of domestic and international marketing opportunities is only possible upon condition of their standardization. In developing regulations for assessing quality of oilseed flax straw stems and fibres obtained in order to determine the scope of industrial application, it is necessary to take into account their specific anatomical, physical and mechanical properties.

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