

# Leguminous Crops as a Valuable Product in Functional Nutrition

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**Abstract**— The issue of healthy nutrition is nowadays one of the most important concerns for everybody. Research is being intensively carried out and scientific works published about legumes as crops possessing functional properties. The present article describes the useful properties of cultures such as dry and green beans, green peas and chickpeas and their role in improving human nutrition and health. It has been established that green bean varieties bred at the Omsk State Agrarian University have high protein content in their green pulses (up to 23.60 %) and contain the following micronutrients: zinc (up to 26.12 %), iodine (up to 0.016 mg/kg), iron (3.1 mg/kg) and sucrose (up to 4%) in the phase of horticultural maturity; the locally bred varieties of dry beans exhibit high protein content in the seeds (up to 24 %), as well as the following micronutrients: zinc (up to 28.1 %), iron (up to 80 mg/kg), iodine (up to 0.23 mg/kg) and calcium (up to 0.85 mg/kg); chickpea samples distinguish themselves as for high protein content (up to 23.54 %), calcium (up to 0.82 mg/kg), zinc (up to 45.6 %), iodine (up to 0.76 mg/kg) and iron (up to 66 mg/kg) along with optimal technological characteristics of seeds and green pulses. Varieties with a set of valuable parameters have been identified.

**Keywords**— variety, bean, pea, chickpea, proteins, micro- and macronutrients, vitamins, sucrose.

## I. INTRODUCTION

Leguminous crops such as beans, peas, lentils, broad beans and chickpeas are key components in a healthy diet, yet their nutritional potential is unfortunately underestimated, thus their consumption remains at a low level. Legumes contain a high share of proteins and fibres, as well as a low share of fats. They are rich in nutritional substances, including vitamins and micronutrients. Along with meat and fish, legumes are classified as protein-containing products and are valuable sources of vegetable proteins, representing an optimal alternative to animal proteins, which are more expensive; for this reason, they are ideal for improving the diet of all segments of the population and an important component of the daily food intake. This can be confirmed by data on their food energy, protein, fat and carbohydrate content for 100 g of products (Table 1) [1, 2].

TABLE I. FOOD ENERGY AND NUTRITIONAL VALUE OF THE SEEDS OF LEGUMINOUS CROPS

Legumes	Water	Proteins	Fats	Carbohydrates	Food energy, kCal
Broad beans	83.0	6	0.1	8.3	58
Green peas	80.0	5.0	0.2	8.3	55
Dry peas	71.0	10.3	0.8	20.4	130
Chickpeas	-	19.8	3.4	48.6	304
Dry beans (white-coloured)	14.0	22.3	1.7	4.3	309
Green beans (green pulses)	90.0	4.0	0.0	4.3	32
Lentils	14.0	24.0	1.5	46.3	295

Legumes deserve more attention, as they are of crucial importance for healthy nutrition, for the sustainable production of foodstuff and, in addition, for food security.

For many centuries leguminous crops have covered a crucial role in human diet all over the world. Beans, peas and chickpeas can be consumed both in their green and dry form. They represent a rich source of vegetable proteins, carbohydrates, group B vitamins, micronutrients (potassium, phosphorus, magnesium and iron) and fibres, and they contain antioxidants which can counter the natural ageing process. An important factor is represented by the fact that under the local climatic conditions they guarantee a valuable protein-containing production within a relatively short period. Local varieties are the basis of “healthy food” due to their high content of proteins, vitamins, essential amino acids and other biologically valuable substances [2, 3].

Legumes can produce superior, more assimilable and cheaper proteins per unit area than agricultural plants from other families. They can also activate air nitrogen, which is not available to other plants, in the biological cycle. Legumes improve soil as well, thus they are optimal forecrops for many cultures.

Leguminous crops represent only 2.1 % in the production structure of grains in the Russian Federation. It should be noted that over the last few years the area cultivated under legumes has become more stable in the country and increased up to 1,617,000 ha in 2016 [4].

For these reasons, the overall increase in areas cultivated under leguminous crops, the expansion of their range, and the introduction of new, non-traditional crops such as dry and green beans, green peas and chickpeas are needed in the region. The study of the chemical composition and nutritional value of their grains and green pulses is of crucial importance.

The aim of the research was a comparative assessment of selected samples of dry and green beans, green peas and chickpeas as regards the content of proteins, micronutrients (zinc, iodine, iron and calcium) and sucrose in their grains and green pulses, as well as their processing characteristics (cooking time, presence of parchment layer and fibres in the string, form and thickness of pulses) and taste properties.

## II. METHODS

The research was carried out on the Educational and Experimental Field of Omsk State Agrarian University, located in the southern forest-steppe of the Omsk Region, in 2016-2018. The southern forest-steppe is characterised by a warm, mildly humid climate. The sum of the average daily temperatures for the period with a temperature over 10 °C amounts to 100-130 days on average. The frostless season in this area amounts to 110-120 days on average, the period with temperatures over 10 °C to 123 days. The abundance of sunny and warm days significantly compensates the shortness of the frostless season and guarantees plant vegetation. The southern forest-steppe of the Omsk Region can be classified as an area of inconsistent humidity. Moisture provision to plants is locally characterised by a hydrothermal coefficient of 1.0-1.2, which shows an insufficient average moisture provision in the period of active vegetation. By sowing time moisture deposits in the soil are usually sufficient. The soil in the field is common chernozem with average thickness and average humus content.

Object of the research were the following samples and varieties of leguminous crops: dry and green beans, green peas, and chickpeas.

Observation, record keeping and analysis were carried out under field conditions following the methodological guidelines for the study of leguminous crop collections (All-Russian Institute of Plant Industry, 1975) and for the study of samples from the world bean collection (All-Russian Institute of Plant Industry, 1987).

The biochemical analysis of green pulses was carried out in the testing laboratory of the Omsk branch of the Federal State Budgetary Institution "Federal Centre for the Assessment of the Safety and Quality of Grains and Processed Products". The sucrose content of green pulses was determined using a refractometer "Refracto 30P". The statistical elaboration of experimental data was carried out following the methodology proposed by B.A. Dospikhov (1985).

## III. RESULTS AND DISCUSSION

In ancient Rus' bean pods were called "Constantinopolitan beans", while later they were called "Turkish beans".

Several types of beans exist, including common beans, red runner beans, lima beans, adzuki beans, mung beans, tepary beans, and others. Varieties with a sugary pod without parchment layer and fibres are classified as green beans. In the case of green beans, unripe pods and seeds are consumed

as food only after boiling or stewing. They are rich of proteins, which can be compared to meat proteins as regards their composition. Unripe pods can contain up to 6 % of proteins and vitamins A, B, C, up to 3.4 % of sugars, up to 3.9 % of dietary fibres, ascorbic acid and mineral salts. The harvesting of green beans for green pulses (or pods) in the Omsk Region begins 8-10 days after the formation of the stem, when the seeds reach the dimensions of wheat grains. In addition, the pods have juicy and succulent blades and are optimal for consumption as food. It should be noted that the outlooks of the Russian market of frozen green beans are really promising, since such market is facing a quick and intense development. In vegetable production, varieties with rounded, succulent pods, without fibres in the strings and parchment layer in the blades, characterised by a high content of proteins, sugar, vitamins and mineral salts are appreciated [1, 2].

The study of the biochemical composition and processing qualities of green bean pods for different types of processing remains of crucial importance. The green pods of several bean varieties have been evaluated as regards their manufacturability in the phase of horticultural maturity.

In locally bred varieties, green bean pods in the phase of horticultural maturity distinguish themselves from the control sample due to a higher succulence (3 points) and an even shape, while the parchment layer in the pod blades is absent. The pods present a rounded cross-sectional shape, a thickness ranging from 0.8 to 1.0 cm, which is consistently higher by 0.2 cm if compared to the control sample. Such parameters testify a high level of suitability of locally bred bean varieties for freezing and canning.

The content of proteins as well as micro- and macronutrients in the green pods of bean varieties bred in Omsk is presented in Table 2.

TABLE II. BIOCHEMICAL COMPOSITION OF GREEN BEAN PULSES BRED AT OMSK STATE AGRARIAN UNIVERSITY, 2016–2018

Variety	Weight fraction of absolute dry matter			
	protein, %	zinc, mg/kg	iodine, mg/kg	iron, mg/kg
Pol'ka, control sample	19.48	19.94	0.014	1.7
Zoloto Sibiri	18.62	22.49	0.014	1.6
Pamyati Ryzhkovoy	19.02	25.81	0.015	2.0
Marusya	21.11	22.66	0.015	2.1
Sibiryachka	19.91	26.12	0.016	2.3
Average	19.63	24.40	0.015	1.9
LSD <sub>05</sub>	2.94	3.51	0.002	0.3

The protein content in the green pods of the bean varieties at study varied over the research period from 17.75 % under wet and moderately cold conditions to 23.60 % under arid conditions. The highest protein content was observed in the varieties Marusya with an average of 21.11 % and Sibiryachka with an average of 19.91 %.

The weight fraction of zinc in the green pods of local varieties ranged between 22.49 mg/kg and 26.12 mg/kg. The highest zinc content was observed in the varieties Sibiryachka with 26.12 mg/kg and Pamyati Ryzhkovoy with 25.81 mg/kg.

The iodine content in green pods varied from 0.014 to 0.016 mg/kg over research period. The highest iodine content in green pods was observed in the variety Sibiryachka with 0.016 mg/kg.

The highest iron content in green pods was observed in the varieties Sibiryachka (2.3 mg/kg), Marusya (2.1 mg/kg) and Pamyati Ryzhkovoy (1.8–3.1 mg/kg).

Subsequently, the green bean varieties bred at Omsk State Agrarian University, possessing a stable high content of proteins as well as micro- and macronutrients in green pods, are to be recommended as a source for plant breeding for quality.

An important role in the plant is played by sugars, which can be found in the plant cells in the form of deposits, especially in the cell sap, or are directly expended all over the plant as a nutritional and energetic material.

The evaluation of green bean pods as regards their sucrose content in the period of horticultural maturity during the second and third harvest (18th July and 3rd August) opens the way for recommending the ideal harvesting time (Table 3).

TABLE III. SUCROSE CONTENT IN GREEN BEAN PULSES BRED AT OMSK STATE AGRARIAN UNIVERSITY, 2016–2018, %

Variety	Horticultural maturity		
	II harvest (18/07)	III harvest (03/08)	Average
Pol'ka, control sample	3.6	0.7	2.2
Zoloto Sibiri	3.7 <sup>a</sup>	1.9 <sup>a</sup>	2.8 <sup>a</sup>
Pamyati Ryzhkovoy	4.0 <sup>a</sup>	2.2 <sup>a</sup>	3.1 <sup>a</sup>
Marusya	3.8 <sup>a</sup>	1.2 <sup>a</sup>	2.5 <sup>a</sup>
Sibiryachka	3.8 <sup>a</sup>	1.5 <sup>a</sup>	2.7 <sup>a</sup>
Average	3.7	1.5	2.6
LSD <sub>05</sub>	0.2	0.3	0.3

<sup>a</sup>. consistent with P>05

As a part of the research, it has been established that pods possess a higher sucrose content during the second harvest (with an average of 3.7 %). In the subsequent harvest a significant reduction in the sucrose content down to 1.5 % (2.5 times) was observed. As a consequence, a high sucrose content in green pods can be guaranteed by harvesting in the second third of July, while in case of later harvesting the sucrose content is consistently reduced. The highest sucrose content during the first harvesting was observed in the variety Pamyati Ryzhkovoy (4.1 %).

Over the research period the average yield of green pods ranged from 356.7 to 602.2 g/m<sup>2</sup> and was consistently higher than that of the control sample. The highest yield of green pods was observed in the variety Pamyati Ryzhkovoy with 563.4 g/m<sup>2</sup> (in 2016), 622.8 g/m<sup>2</sup> (in 2017) and 620.4 g/m<sup>2</sup> (in 2018).

Dry beans have been a widespread food product since ancient times. In Russia they became known in the XVII century. Mature seeds are consumed as food. Their proteins are similar to animal proteins as for chemical composition and biological value. Up to 30 essential amino acids are included in the chemical composition of bean proteins. Thanks to their high biological value and protein content beans are called “vegetable meat”, since they can completely substitute it in human nutrition. The recommended daily intake of proteins for an adult person amount to 1–1.5 g per kg of body weight. Consuming 100 g of beans guarantees the fulfilment of the daily intake as follows: dietary fibres up to 41 %, vitamin B1 up to 33 %, vitamin B3 up to 24 %, vitamin B6 up to 45 %, vitamin B9 up to 23 %, vitamin PP up to 32 %, calcium up to 15%, magnesium up to 26%, potassium up to 44 %,

phosphorus up to 60 %, sulphur up to 16 %, iron up to 33 %, zinc up to 27 %, copper up to 48 %, manganese up to 67 %, chrome up to 20 %, molybdenum up to 56 %, boron up to 25 %, vanadium up to 475 %, and cobalt up to 187 %. They contain 0.02 mg of β-carotene, 3.84 mg of vitamin E (tocopherol), 0.5 mg of vitamin B1 (thiamin), 0.18 mg of vitamin B2 (riboflavin), and 90 µg of vitamin B9 (folic acid). The majority of these micronutrients are catalysers, and the micronutrient composition heavily influences biocolloids and the directionality of biochemical processes [3, 5].

The content of proteins, micro- and macronutrients, colouring and cooking time are important factors for the evaluation of dry bean seeds consumed as food products [2]. The protein content in the seeds (grains) of dry bean varieties bred at Omsk State Agrarian University ranged from 21.22 to 24.06 %. Four dry bean varieties were consistently superior to the control sample: Sizaya (24.06 %), Luker'ya (23.38 %), Omskaya yubileynaya (22.60 %), and Olivkovaya (23.13 %) (Table 4).

TABLE IV. BIOCHEMICAL COMPOSITION OF DRY BEAN SEEDS BRED AT OMSK STATE AGRARIAN UNIVERSITY, 2016–2018

Variety	Content				
	proteins, %	zinc, mg/kg	iodine, mg/kg	calcium, mg/kg	iron, mg/kg
Nerussa, control sample	19.07	20.7	0.10	0.10	21.1
Sibakovskaya-100	21.22	25.5 <sup>a</sup>	0.20 <sup>a</sup>	0.24 <sup>a</sup>	10.0
Sizaya	24.06 <sup>a</sup>	24.3	0.19 <sup>a</sup>	1.35 <sup>a</sup>	54.0 <sup>a</sup>
Luker'ya	23.38 <sup>a</sup>	20.9	0.23 <sup>a</sup>	0.33 <sup>a</sup>	80.0 <sup>a</sup>
Omskaya yubileynaya	22.60 <sup>a</sup>	27.8 <sup>a</sup>	0.15 <sup>a</sup>	0.24 <sup>a</sup>	12.0
Olivkovaya	23.13 <sup>a</sup>	28.1 <sup>a</sup>	0.21 <sup>a</sup>	0.85 <sup>a</sup>	17.0
Omichka	21.82	26.9 <sup>a</sup>	0.19 <sup>a</sup>	0.60 <sup>a</sup>	10.0
Average	22.18	24.9	0.18	0.53	26.44
LSD <sub>05</sub>	3.30	3.7	0.03	0.08	3.97

<sup>a</sup>. consistent with P>05

Zinc content in the seeds of the dry bean samples ranged from 20.9 to 28.1 mg/kg. A high zinc content was observed in the seeds of the following locally bred varieties: Sibakovskaya-100 (25.5 mg/kg), Omskaya yubileynaya (27.8 mg/kg), Olivkovaya (28.1 mg/kg), and Omichka (26.9 mg/kg), which possess a significant increment if compared to the control sample. The average iron content in dry bean varieties varied between 10.0 and 80.0 mg/kg. The highest iron content was observed in the varieties Luker'ya (80.0 mg/kg) and Sizaya (54.0 mg/kg).

All the varieties created at Omsk State Agrarian University were significantly superior to the control sample Nerussa as regards their iodine and calcium content. The iodine content in locally bred varieties is more than twice as much as in the control sample and ranges from 0.15 to 0.23 mg/kg. The highest iodine content was observed in the varieties Luker'ya (0.23 mg/kg) and Olivkovaya (0.21 mg/kg). The average calcium content in the new dry bean varieties varied between 0.24 and 0.85 mg/kg. The highest calcium content was observed in the varieties Olivkovaya (0.85 mg/kg) and Omichka (0.60 mg/kg).

An important feature which testifies the quality of dry bean grains is their cooking time rate, which depends on the shape of the seeds, their water absorbing capacity, thickness

and share of seed coat, provision of mineral nutrients during the seed formation and ripening phases. All the new locally bred varieties possess an optimal cooking time (ranging from 57 to 67 min) and were classified as 1<sup>st</sup> category (Table 5).

TABLE V. COOKING TIME OF DRY BEAN SEEDS BRED AT OMSK STATE AGRARIAN UNIVERSITY, 2016–2018

Variety	Seed colouring	Cooking time, min.			
		2016	2017	2018	Average
Nerussa, control sample	white	58	60	59	59
Sibakovskaya-100	white with a dark cherry-coloured pattern around the hilum	60	61	60	60
Sizaya	glaucous	57	58	57	57
Luker'ya	black	57	59	58	58
Omskaya yubileynaya	beige with a brown pattern	65	67	66	66
Olivkovaya	olive green	60	63	61	61
Omichka	white with glaucous marks	58	60	59	59
Average	-	59	61	60	60

The lowest cooking time was observed in the varieties Sizaya (57 min) and Luker'ya (58 min).

The analysis of sugar content in the leaves along different plant growth phases allowed for the selection of the following varieties: Omichka, Olivkovaya, Luker'ya and Sizaya, in which the parameter varies from 10.0 to 15.4 % (Table 6). The highest sugar content in the leaves was observed before the milky ripeness phase, along with the plant ripening the sugar content progressively decreased. By the time of the last evaluation of this parameter (27<sup>th</sup> July) in the early ripening varieties Omskaya yubileynaya and Omichka the amount of sugar in the leaves had significantly decreased and varied between 8.8 % and 10.5 % depending on the variety, due to the fact that sugars along with the ripening of pulses are progressively transformed into starch [1].

TABLE VI. SUCROSE CONTENT IN THE LEAVES OF DRY BEANS BRED AT OMSK STATE AGRARIAN UNIVERSITY, 2016–2018, %

Variety	Phase			Average
	Efflorescence (22/06)	Pulse set – milky ripeness (12/07)	Milky ripeness – early seed ripening (27/07)	
Nerussa, control sample	9.5	11.0	9.1	9.9
Omskaya yubileynaya	9.6	12.8	8.8	10.4
Omichka	11.5	14.0	10.5	12.0 <sup>a</sup>
Olivkovaya	10.1	13.3	15.4	12.9 <sup>a</sup>
Luker'ya	11.3	14.8	14.9	13.7 <sup>a</sup>
Sizaya	10.4	10.0	15.0	11.8 <sup>a</sup>
Average	10.4	12.7	13.5	12.2
LSD <sub>05</sub>	1.6	1.9	2.0	1.8

<sup>a</sup> consistent with P>05

The dry bean varieties bred at Omsk State Agrarian University distinguish themselves for their high yielding capacity. Over the period of research their yield varied between 1.5 and 5.7 t/ha. The highest yield was obtained in 2016 with an average of 4.1 t/ha, whereas the lowest was

obtained in 2017 with 2.3 t/ha. The varieties Sibakovskaya-100, Luker'ya, Sizaya, Omskaya yubileynaya and Olivkovaya are consistently superior to the control sample as for yield.

Subsequently, the new dry bean varieties bred at Omsk State University are to be classified as medium ripening with high yielding capacity of seeds and high protein content in grains (more than 23 %) as well as good cooking time (from 57 to 67 min), and are suitable for canning. The obtained bean varieties comply with the model elaborated for the conditions of the southern forest-steppe of Western Siberia and are competitive if compared to their foreign analogues.

Peas are a valuable food product, rich in proteins, vitamins and mineral salts, as well as an optimal functional product for the prevention of atherosclerosis and osteoporosis.

Peas are a source of group B vitamins such as B1, B2, B3 (niacin) and B6, i.e. the catalisers of the carbohydrate, protein and lipid metabolisms which participate to the central nervous system functioning. Peas can be recommended in case of mental tiredness, insomnia, irritability, and functional heart disorders. The natural sugar present in most pea varieties triggers an improvement in memory and cerebral activity [6-8].

The processing characteristics and taste evaluation of the pulses of green pea samples studied at Omsk State Agrarian University are presented in Table 7.

TABLE VII. PROCESSING CHARACTERISTICS AND TASTE EVALUATION OF GREEN PEA PULSES, 2016–2018

Sample	Taste, points	Parchment layer, +,- <sup>a</sup>	Fibres, +,- <sup>a</sup>	Pulse colour
Neistoshchimyy 195, control sample	4.4	-	-	green
Chika	4.7	+	-	dark green
Glorioza	4.0	-	+	green
Sovinter	4.3	+	-	green
Bondi	4.8	-	-	green
Norli	4.7	-	+	green
Kitayskiy	4.8	-	-	dark green

<sup>a</sup> + if present, - if absent

The green pea samples Kitayskiy and Chika distinguished themselves for their high taste qualities and sugar content (7.5 %), dark green colour of seeds, and big succulent pulses without fibres or parchment layer.

Chickpeas represent one of the oldest agricultural crops, having been cultivated already about 5000 BCE. Their seeds contain 24-25 % of proteins and 5-6 % of oil. The biological value of chickpea proteins amount to 52-78 %, their digestibility to 80-83 %. In addition, the seeds of this crop type contain a rich complex of vitamins, mineral salts and biologically active substances. Many national dishes are made with chickpeas, and they are used a medical and prophylactic agent as well. Their seeds do not contain antinutritional substances, for this reason thermal processing is not needed in order to use it as food or fodder. Chickpea proteins are well balanced in their amino acid content and can be compared to animal proteins. Potassium, calcium and selenium, which are part of their composition, influence the regulation of blood formation and prevent the development of several diseases, promote the prevention of hormonal disorders and cardiac arrhythmia, the dissolution of formations in the gallbladder and urinary bladder, the normalisation of arterial blood

pressure, the fortification of the myocardium, and the increase in the elasticity of blood vessels. Consuming chickpea seeds reduces cellular proliferation, decreases the risk of cancer and inhibits precancerous lesions [9-12].

Chickpea seeds contain linoleic and oleic fatty acids which are needed for the realisation of growth processes and different physiological functions. As they are not synthesised in the human body, the maintenance of their level depends only on their assumption through food. The content of proteins and micronutrients in the selected chickpea samples is presented in Table 8.

TABLE VIII. FEATURES OF SELECTED CHICKPEA SAMPLES AS REGARDS THE BIOCHEMICAL COMPOSITION OF SEEDS, 2015–2017

Sample	Weight fraction of absolute dry matter				
	proteins, %	calcium, mg/kg	zinc, mg/kg	iodine, mg/kg	iron, mg/kg
<b>2014</b>					
Krasnokutskiy-123, control sample	19.75	0.70	28.35	0.04	-
ILC-482	21.45	0.75	31.62	0.01	-
Line S-80	20.84	0.80	39.38	0.06	-
Line S-243	18.69	0.82	28.25	0.04	-
LSD <sub>05</sub>	3.03	0.12	4.79	0.01	-
<b>2016</b>					
Krasnokutskiy-123, control sample	20.08	0.70	30.42	-	-
Volgogradskiy 10	20.19	0.72	26.49	-	-
Line S-80	23.44	0.61	40.08	-	-
Line S-27	21.31	0.81	38.54	0.76	-
Privo 1	19.56	0.73	38.65	0.74	-
LSD <sub>05</sub>	3.14	0.11	2.69	0.11	-
<b>2017</b>					
ILC-2394	21.47	0.05	30.5	-	66
Line S-35	23.44	0.03	45.6	-	36
Line S-2402	23.53	0.03	25.3	-	54
LSD <sub>05</sub>	3.42	0.01	5.07	-	7.8

The biochemical analysis of the seeds of selected collection samples of chickpeas shows a high protein content ranging from 19.75 to 23.5 %, zinc content from 25.3 to 45.6 mg/kg, and iodine content from 0.01 to 0.76 mg/kg. The highest protein content was observed in the following chickpea samples: Line S-80, Line S-35 and Line S-2402; the highest calcium content, in Line S-243 and Line S-27; the highest zinc content, in Line S-80 and Line S-35; the highest iodine content, in Line S-27; and the highest iron content, in ILC-2394.

#### IV. CONCLUSIONS

The introduction of leguminous crops in the diet solves two typical problems of the XXI century at the same time: famine and unbalanced nutrition.

The obtained data have shown the high potential of the nutritional value of leguminous crops such as dry and green beans, chickpeas, and green peas consumed either in their green or mature form in order to improve human nutrition.

The conclusions about the high content of proteins, micro- and macronutrients, high content of antioxidants, and potential positive effect of leguminous crops in reducing the

risk of different chronic diseases are coherent with that from US scientists [13].

To sum up, it should be noted that the overall increase in areas cultivated under leguminous crops, the expansion of their range, among others by introducing new, non-traditional crops, is necessary. The expansion of the range and of the cultivation area of the analysed crops in Siberia can take place only by means of selection and introduction of new varieties adapted to the local conditions.

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