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Justification of the expediency of using sprouted quinoa grain as part of mixed feeds for birds

IsmatovaShakhnozaNusratulloyevna.[1],IsabayevIsmoil Babadjanovich[2], ErgashevaKhusnirabo Bobonazarovna[3], YuldashevaShabon Jumayevna[4], KhujakulovaNilufar Fayzullayevna[5]
Bukhara Institute of Engineering and Technology,Bukhara, Uzbekistan

Abstract

The article analyzes the main problems of feed production and the main directions of solving them mainly through the use of unconventional raw materials and the use of various methods of processing plant raw materials. It is proved that the use of highly effective methods of biotechnological processing makes it possible to solve integral problems of both the feed industry, and to reduce the anthropogenic load on the environment, successfully solve acute environmental problems. As a promising raw material for the production of compound feeds in order to replace traditional crops, it is recommended to use quinoa.. Quinoa (Lat.Chenopodiumquīnoa) or quinoa is a "pseudo-grain" annual plant of the Amaranth family (Latin Amaranthaceae) of the genus Mar (Lat. Chenopodium) is able to adapt to weather changes and allows saving water, which makes it an excellent alternative in the context of growing problems in food and feed production in Central Asia, the above-mentioned properties of quinoa are being studied within the framework of the project entitled: "Interregional Partnership for improving Food and Food Security in marginal environments of Central Asia", coordinated by the ICBA and with the financial support of the Islamic Development Bank. The overall goal of the project is to improve food security and nutrition of the low-income population living in marginal regions of Central Asia through the introduction of an environmentally sustainable and nutritious quinoa culture. The target countries of the project are Kyrgyzstan, Tajikistan and Uzbekistan, a comparative analysis of the nutritional value of the components of quinoa with feed wheat grain was made. The purpose of the study was to substantiate the feasibility of using quinoa to increase the nutritional value of compound feeds. The changes are analyzed and the main patterns of changes in the main components of the bek and carbohydrate complexes of grain during germination are revealed. The possibility of replacing the latter in the feed composition with the studied raw materials is justified. The expediency of germination of quinoa grain (seeds) for a significant change in the chemical composition of the feed product, its nutritional and biological value is proved. The experimental part of the work was performed in the laboratories of the Department of Food Technology of the Bukhara Institute of Engineering and Technology. In the work, we used traditional methods of analysis for laboratories of feed production.

***Keywords*:** poultry, compound feed; feed base, quinoa, germination, nutritional value, safety.

Introduction

Increasing the production of poultry products is an important link in the complex of measures aimed at meeting the needs of the population in food products, the demand for which is constantly growing. In the modern practice of animal husbandry, the intensification of meat production is based on improving the system of rationing of poultry feeding in order to ensure its needs for highly digestible biologically active substances necessary to strengthen the resistance and activity of immunity, resistance to various diseases, and increase productivity.

In the structure of the cost of poultry products, the cost of compound feed is the main cost item (more than 70.0%), Obtaining high-quality feed is also difficult due to the shortage of traditional raw materials:

wheat, corn, protein feeds (meat and bone meal, fish meal, meal, cake, etc.), feed additives and biologically active substances (amino acids, vitamins, mineral salts, enzymes, etc.), as well as its constantly growing cost. Therefore, the reduction of this flock of expenses is one of the main ways to increase the profitability of the poultry industry.

The expansion of the feed base is associated with the development of new resource-saving technologies, scientifically-based recipes for feed additives and purposeful correction of the chemical composition of compound feeds through the use of natural non-traditional and secondary raw materials of various branches of the processing and food industry, containing a complex of physiologically significant nutrients, especially proteins and essential amino acids.

The use of unconventional raw materials in the technology of compound feeds solves a number of important tasks: reducing the share of valuable grain raw materials in the composition of compound feeds, therefore, reducing their cost;

improving the environmental situation; when using pectin – containing raw materials with complexing properties, solving the problem of toxic elements, radionuclides, pesticides and other dangerous substances entering the human body through animal products. Therefore, the development of new formulations of compound feeds based on non-traditional plant raw materials, including secondary ones, is one of the most priority areas of scientific research in this field.

The development of new formulations of compound feeds based on natural plant raw materials is one of the most priority areas of scientific research in this field. It is especially important to enrich compound feeds with natural protein-containing ingredients in order to reduce the use of hormonal drugs that stimulate the growth of farm animals and birds.

Of scientific and practical interest are alternative salt-and drought-resistant forage crops in crop rotations or in order to replace traditional crops that are difficult or practically impossible to grow under these conditions. In this aspect, special attention is paid to quinoa. The above-mentioned properties of quinoa are being studied within the framework of the project entitled: "Interregional Partnership for Improving Food and Food Security in Marginal Environments of Central Asia", coordinated by the ICBA and with the financial support of the Islamic Development Bank. The overall goal of the project is to improve food security and nutrition of the low-income population living in marginal regions of Central Asia through the introduction of an environmentally sustainable and nutritious quinoa culture. The target countries of the project are Kyrgyzstan, Tajikistan and Uzbekistan [1].

Thus, quinoa seeds, in addition to food needs, can be used for feeding livestock and poultry as well as its green biomass and crop residues. It is assumed that the quinoa culture will be successfully adopted by farmers in marginal regions, and, ultimately, will contribute to the diversity of the diet of rural residents, as well as to feed production and food security of the target countries participating in the project. At the same time, rural regions with limited resources will be able to increase the volume of food and feed. Moreover, public seed production enterprises and small machinery manufacturers will also benefit from the growth in demand for seeds and agricultural machinery, respectively.

However, the phytochemical composition and biotechnological potential of this unique medicinal plant have not yet been sufficiently studied. In this regard, the study of the prospects for the use of drugs from medicinal plant raw materials growing in Uzbekistan in the baking industry of the food industry is relevant, technologically, socially and economically justified.

The purpose of the work was to substantiate the feasibility of using quinoa to increase the nutritional value of compound feeds.

MATERIALS AND METHODS

The work used the variety of quinoa "Barusha" (Application for admission No. 70421, registered 2016-11-11 in the Register of the State Export Commission of the Russian Federation), zoned in different agroecological zones of Uzbekistan.

In the studied raw materials, the mass fraction of dry matter according to GOST 31640-2012 " Feed. Methods for determining the dry matter content", the mass fraction of protein and protein - according to GOST 13496.4-93 " Feed, mixed feed, feed raw materials. Methods for determining the content of nitrogen and crude protein", fat - according to GOST 13496.15-2016 " Feed, mixed feed, feed raw materials. Methods for determining the content of raw fat", fiber - according to GOST 31675-2012 " Feed. Methods for determining the content of crude fiber", ash - according to GOST 26226-95 " Feed, mixed feed, feed raw materials. Methods for the determination of crude ash", nitrogen-free extractable substances (BEV) were determined by the calculation method [2]. The amino acid composition of quinoa grains (seeds) was determined using an automatic Chromospect analyzer; the fatty acid composition was determined by gas - liquid chromatography (GC); the mass fraction of vitamins was determined by chromatographic separation of a sample previously purified from proteins on a thin layer of silica gel with further manifestation in ultraviolet light and quantitative spectrophotometry; mineral composition - using an atomic absorption spectrophotometer AAS-1 (Germany) according to the instructions for the device. The exchange energy (OE) was determined by the calculation method [3].

Assessment of the sanitary and hygienic condition of raw materials for compliance with the safety criteria of SanPiN No. 0366-2019 and Regulation of the EEC Commission No. 1881/2006 [4]. Toxicological indicators for the content of lead, cadmium, mercury and arsenic were determined by GOST 31262-2004 and O'zDSt ISO 6635:2013, mycotoxins - according to GOST 34140-2017, aflatoxin B1 - according to GOST 31748-2012 (ISO 16050:2003), pesticides - according to GOST 31481-2012.

DISCUSSION

The transformation processes of the country's economy have led to a sharp increase in prices for grain, its processed products, as well as transportation and storage. The tangible result of these changes was an increase in feed production costs and, as a result, the unprofitability of livestock enterprises, which in turn led to a sharp decrease in production.

Due to a decrease in the volume, assortment, quality and an increase in prices for high-protein raw materials, the feed industry has problems with the production of full-fledged, balanced in nutrients, in particular in protein, compound feeds, which caused a reduction in their production and a decrease in the number of livestock and poultry [5,p.17-19; 6,p. 197-209].

To solve the problem facing the feed industry, it is necessary to search for new alternative sources of raw materials, create a variety of feed additives based on them for effective replenishment of raw materials, improve the quality and ensure the safety of feed products [7,p.39-48; 8,p. 540-544].

The use of the existing practical and scientific base, modern resource-saving techniques and methods of processing plant raw materials, in particular the use of highly effective methods of biotechnological processing, allows us to solve integral problems of both the feed industry, and to reduce the anthropogenic load on the environment, successfully solve acute environmental problems [9, pp. 129-131].

One of the ways to solve this problem is the use of non-traditional types of feed in the poultry diet as sources of protein (sorghum, triticale) nutrition. Thus, the content of crude protean in sorghum (Sorghum) ranges from 11.7...12.2%, crude fiber and fat – 1.5...5.8 and 4.3...4.4%, respectively. In terms of the content of most essential amino acids, sorghum is almost on the same level as triticale, and in terms of the number of individual ones, it surpasses corn. However, the limiting factor of the use of this crop in feeding laying hens is the presence of tannin in it, so the dosage of sorghum in feed mills should not exceed 20.0%. Wheat-rye hybrid triticale (Triticale), obtained by combining the chromosome complexes of wheat (Triticum) and rye (Secale), which has a number of advantages relative to wheat and rye. Thus, triticale contains more protein (15.0...18.0%), its high energy saturation allows it to replace up to 60.0% of wheat in mixed feeds [10, pp. 175-177].

The most important source of biologically valuable feed and vegetable protein and especially a number of deficient amino acids, primarily lysine, are leguminous crops. At the same time, the main preference is given to soy and its processed products. Grain of fodder leguminous crops and products of its processing contain from 20.0 to 50.0% protein [2, pp. 60-62]. It was found that the grain of cereals contains from 7.0 to 18.0% protein, and feed grain is usually less than 12.0%. The proteins of leguminous seeds are richer in lysine per weight unit of protein compared to all types of cereals. With the help of grains of many legumes, it is possible to balance compound feed not only by the total protein content per feed unit, but also by the content of lysine in it - a source of vegetable protein [10, p. 80-151; 11, p.25-28].

It should be noted that legumes, like other plant species, are able to synthesize anti-nutritional substances that have an inhibitory effect on the proteolytic enzymes of the gastrointestinal tract when used for food or livestock feed (trypsin inhibitors, chymotrypsin), affecting the digestibility of nutrients and minerals (tannins, phytic acid, metal-binding components, lectins), as well as taste qualities (saponins). Thus, 4 protease inhibitors were found in bean seeds: trypsin, chymotrypsin, elastase or pancreatopeptidase E, subtilpeptidase A. Moreover, legumes contain harmful substances of toxic action (cyanogenic glycosides, alkaloids) [12, p. 282; 13, p. 26-29; 14, p. 275-283].

An alternative to grain crops in mixed feeds can be Jerusalem artichoke (Helianthus tuberosus L.), or ground pear, a perennial large-herb plant. The aboveground part of the plant (the yield of the green mass is 50 ... 70 t / ha) is a valuable feed product that is well siloed, and in terms of feed value is not inferior to corn. Studies [15, p. 46-47] have shown that 100 kg of green mass contains 23 feed units, while the green mass of corn contains 15. It is richer than other crops in proteins (21.0%), carotene, inulin (15.0...35.0%), sugars and amino acids, vitamins, mineral elements. A significant difference between Jerusalem artichoke and other vegetables is manifested in the high content of protein in its tubers (up to 3.2% per dry substance), which includes all the irreplaceable amino acids. Vitamins B1, B2 and C in it are almost 3 times more than in potatoes, carrots and beets.

For use in the composition of compound feeds for laying hens of egg crosses, it is recommended to use millet (Lat.Panicum is a genus of annual and perennial herbaceous plants of the Grass family, or Bluegrass (Poaceae). Along with drought resistance, the advantages of this crop are such qualities as small-seeding, early maturity, a wide range of sowing periods, the duration of seed storage. It was found that 100 g of millet contains: 12.0% crude protein-12.0, crude fiber -5.5, lysine-0.33, methionine and cystine-0.53%. In terms of the content of raw protein and lisi, millet is not inferior to wheat, and in terms of the presence of methionine + cystine, it exceeds it by 55.8%. The grain contains a relatively high amount of phosphorus, zinc, iodine, potassium, sodium, bromine, and vitamins B1 and B2 in it are almost 2 times more than in wheat grain [16,pp. 23-25].

Alimkulov et al. [17,p. 34-37] considered the possibility of using grape pomace and a natural mineral sorbent – vermiculite for the production of mixed feeds. It is established that the secondary raw materials obtained during the processing of grapes, according to their chemical composition, fully meets the requirements for the components of compound feeds. However, the flowability, bulk weight and hygroscopicity of this raw material do not meet the necessary requirements of mixed feed production. In addition, the flour from the pomace quickly becomes rancid and clumps. The introduction of vermiculite, rich in mineral elements, into the composition of the feed additive, which increases the body's resistance to diseases, the efficiency of the degree of assimilation of nutrients of the feed, which prolongs the cycle of peak productivity and the quality of eggs, allows improving the structural and mechanical properties of grape processing products and obtaining an environmentally friendly product.

Sapropels or silt additives in the amount of 1.5...3.0% by weight of feed for laying hens are of considerable interest as feed products, which contributes to increasing the yield of products and reducing feed inversion from it. It was found that the use of a silt feed additive in the amount of 1.5% by weight of mixed feed increased the safety of poultry by 2.5%, the increase in live weight – by 4.3%, and its productivity-by 1.5...2.0% [18, pp. 53-56].

There are data on studies on the use of a biologically active additive based on a natural source of bentonite enriched with a green mass from sprouted barley grain in a ratio of 1:20. As a result, an increase in the live weight of chickens was noted and feed consumption decreased [19, p. 59-60].

Another equally effective way to solve the problem of creating full-fledged, nutrient-balanced compound feeds is the use of highly effective methods of biotechnological processing.

To date, in order to increase the digestibility of protein, the destruction of starch and fiber to easily digestible forms, the disinfection of grain and its processed products, such preparation methods are used as [20, p. 51; 21, p. 85-89; 22, p. 12]:

- ➢ - frying in drum-shaped rotating frying units or "frying pans" equipped with stirrers. The heat carrier in the first case can be hot air, in the second - superheated oil circulating in a closed circuit;
- ➢ - steaming and flattening with steam-working smooth rollers to obtain petals or flakes (flaking);
- ➢ -extrusion with the use of press extruders [23, p. 3-9];
- ➢ - micronization - heating of grain using infrared rays [24, p. 78-94];
- ➢ -heating by convective method with a high rate of heat supply in the fluidized bed or pneumatic channel, leading to swelling, "explosion of grain", the formation of irregular flakes;
- ➢ -treatment with ultra-high-frequency fields to improve the sanitary quality and digestibility;
- ➢ -irradiation, electron flux irradiation, explosion-irradiation.

Sometimes, in order to increase the reactivity of the raw material, it is subjected to dry or wet grinding [24, p. 95-106].

All these types of processing contribute to improving the taste and palatability of feed, increase the nutritional value of carbohydrate and protein complexes, while reducing the energy consumption of the animal body for digesting feed nutrients [25, pp. 7-9].

A method for processing cellulose-containing agricultural waste and feed grain has also been developed to improve their digestibility when feeding livestock. To do this, the raw material is treated with an aqueous solution of chlorites having a normality for chlorites in the range of 0.02...0.03 and a pH above 8.5 and taken in an amount of 5.0 to 15.0% of the raw material. Processing is carried out during a period that ensures the conversion of raw materials to a state where it has increased digestibility for livestock to livestock [26, p.9-15].

However, the use of the above methods in the production of feed from secondary raw materials is not always effective [27, p. 20-22].

In the modern practice of food production and processing, there are more efficient and resource-saving technologies, such as bioconversion [81,p.35-38; 64,p. 516-517; 106,p. 28-29; 28,p. 90-98; 29,p. 65-72; 30,p. 54-61].

All methods of processing plant raw materials can be divided into three groups: physical, chemical, and biological. Physical methods of conversion are grinding, pressing (pressing), etc. The conversion of plant raw materials by chemical methods is based on methods of hydrolysis of polysaccharides with solutions of acids and alkalis.

- Hydrolysis with salts-percolation, extrusion treatment with salts;
- Hydrolysis by gaseous agents-prehydrolysis in CO_2 vapors, hydrolysis in SO_2 vapors;
- Alkaline delignification - methods of separating cellulose, including using a steam explosion.

3. Biological:

- Bioconversion of plant raw materials by enzymes;
- Direct bioconversion of plant raw materials by microorganisms (cultivation of microorganisms, various types of fermentation);
- Bioconversion of plant raw materials by enzymes and microorganisms;
- Bioconversion of plant raw materials after hydrolysis by chemical method.

4. Combined:

- Mechanochemical-defibration or grinding in the presence of acids or salts;
- Thermochemical - direct combustion, pyrolysis, gasification, liquefaction, rapid pyrolysis, synthesis of methanol from gas formed during thermal conversion of wood biomass;
- A combination of the above physical and chemical methods, for example, radiolysis in the atmosphere of CO_2, etc.

A promising direction for increasing the biological and nutritional value of compound feeds is the use of sprouted grain in their composition. Grain after germination has a simplified biopolymer structure of carbohydrates, an increased content of easily soluble fractions of non-protein nitrogen and essential amino acids, vitamins [32, pp. 51-53].

RESULT

Quinoa (Lat.Chenopodiumquīnoa) or quinoa is a "pseudo-grain" annual plant of the Amaranth family (Latin Amaranthaceae) of the genus Mar (Lat. Chenopodium is a relative of beetroot and spinach, it is able to adapt to weather changes and allows saving water, which makes it an excellent alternative in the context of growing problems in food and feed production in Central Asia [33; 34, pp. 9-10]. It can be used as a multi-purpose agro-industrial crop, well adapted to extreme soil and climatic conditions. Quinoa is able to adapt to weather changes and saves water, which makes it an excellent alternative in the context of growing problems in food and feed production in Central Asia [1].

Quinoa has a unique amino acid, fatty acid, vitamin and mineral composition, which makes it one of the most useful food products for humans. Quinoa has a unique amino acid, fatty acid, vitamin and mineral composition, which makes it one of the most useful food products for humans and animals. Having a gluten-free composition, quinoa seeds are characterized by an exceptionally high protein content (11.0...18.0%) and a well-balanced amino acid composition; magnesium, phosphorus and potassium, they also contain thiamine, riboflavin, niacin, folic acid, vitamin E. The fatty acid composition of quinoa is close to the oilseeds of rapeseed. The plant has a genetic diversity and is able to adapt perfectly to agricultural and environmental conditions: it grows at a relative humidity of 40.0 to 88.0%, withstands temperatures from -4 to+38 ° and is resistant to lack of moisture. No special soil preparation is required for sowing seeds. Usually, quinoa is grown in a crop rotation with potatoes and wheat. When sowing 15 ... 20 kg per hectare, from 400 to 1200 kg are collected. The plant reaches physiological maturity in a month and a half. Quinoa is also one of the most nutritious food crops currently known. Having a gluten-free composition, quinoa grains are characterized by an exceptionally high protein content (11.0...18.0%) and a well-balanced amino acid composition. The seeds are rich in magnesium, phosphorus and potassium, they also contain thiamine, riboflavin, niacin, folic acid, vitamins B6, B12 and E. The fatty acid composition of quinoa is close to oilseed rape seeds. It is no coincidence that it is called a pseudo-oil culture. It should be noted that quinoa seeds also contain saponins, which can give them a bitter taste. However, this does not reduce the nutritional value of this crop [34, p. 9-10; 35, p. 48-53].

The studies were carried out in 2 stages: germination for 144 hours and drying of quinoa grain (seeds) to a moisture content of 14.0±0.5%. The control was grain without germination.

The results of the study are presented in the figure and in tables 1-4.

The chemical composition and food safety of quinoa grain (seeds) grown in Uzbekistan were studied (Table 1, 2).

A comparative analysis of the studied raw materials with feed wheat grain was performed (Table 1).

Table 1

Chemical composition and nutritional value of quinoa grain (seeds)

Substances	Mass fraction of substances, in % in air-dry matter / grade	
	feed wheat	*quinoa*
Moisture	14,50	13,30
Raw Protein	14,39 / 3	16,38 / 1
Raw fat	2,69 / 3	6,69 / 2
Raw fiber	4,09 / 3	7,96 / 2
Raw ash	3,86 / 1	3,57 / 2
Nitrogen-free extractive substances (BEV)	74,97 / 1	65,40 / 2
AMINO ACIDS: - LYSINE - METHIONINE+CYSTINE	 0,46 / 3 0,48 / 2	 0,62 / 2 0,45 / 3
Mineral substances: - calcium - phosphorus - sodium	 0,05 / 3 0,55 / 2 0,13 / 1	 0,06 / 2 0,52 / 3 0,01 / 2
Exchange energy, kcal	452 / 1	444 / 2
Total rank, score	*23*	*23*

It follows from the data in Table 1 that the studied raw materials have a relatively high nutritional value. At the same time, the grain of feed wheat and quinoa have the same rank value (23 points), that is, they are characterized by almost equal nutritional value.

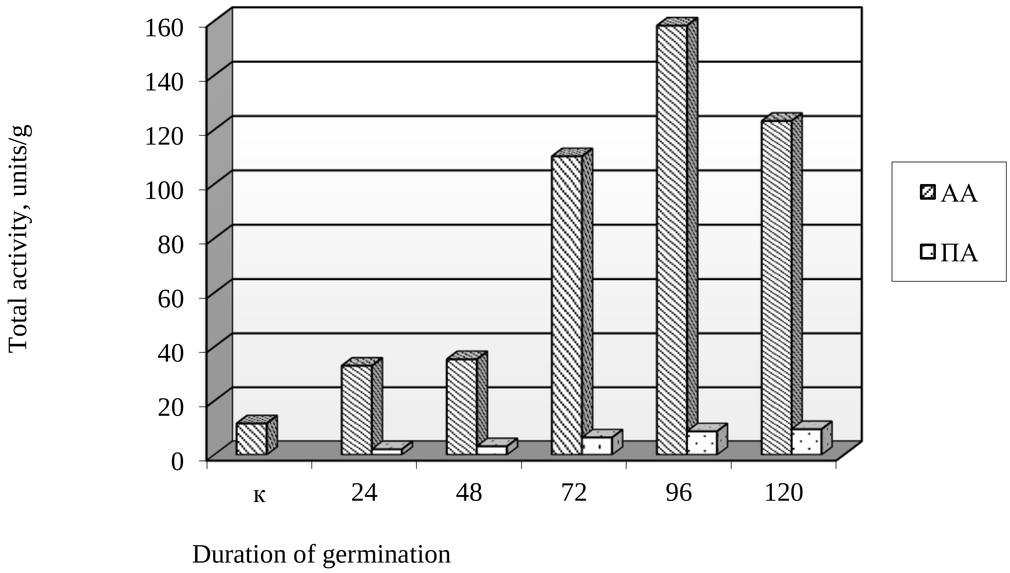
Table 2
Indicators of the level of environmental safety of the studied quinoa grain (seeds)

Indicators	The maximum permissible content of the element, mg/kg		Indicators of the level of samples in grain (seeds), mg/kg
	SanPiN No. 0366-19	EEC Regulations 1818/2006	quinoa
Lead	0,500	0,200	0,223
Cadmium	0,100	0,100	0,036
Mercury	0,030	н/р[1]	н/о[2]
Arsenic	0,200	н/р	н/о
Hexachlorocyclohexane (α -, β-and γ-isomers)	0,500	н/р	footprints
DDT and its metabolites	0,020		н/о
HCB	0,010		н/о
Organomercury compounds	не доп.		н/о
Aflatoxin B1	0,005	0,002	н/о
Deoxynivalenol (vomitoxin)	0,700	1,250	0,027
Zearalenon	1,000	0,100	н/о
T-2 toxin	0,100	0,060	н/о

It was found that the content of toxic elements, pesticides and mycotoxins in the studied quinoa samples did not exceed the MPC, while pesticides and mycotoxins were not detected in them.

The germination of grain (seeds) consists of several stages: swelling, pecking, heterotrophic growth of seedlings, transition to an autotrophic type of nutrition. The starting factor of the beginning of germination is the absorption of water by the seeds. The swelling of seeds practically does not depend on the oxygen content, temperature and lighting. Pecking begins when the grain (seeds) reaches a critical humidity (40.0...65.0 %).

The growth of amylolytic (AA) and proteolytic (PA) enzyme activity in sprouted grain was studied. The dynamics of the growth of the total activity of individual groups of enzymes is shown in Figure 1.



Dynamics of the growth of the total activity of amylolytic and proteolytic groups of enzymes during the germination of quinoa grain

It was found that the growth of AA in grain continues up to 96 hours of germination, then its decrease is observed, while PA continuously increases, so further studies were carried out with grain with a germination period of no more than 120 hours.

The results of changes in protein components in quinoa grains (seeds) are presented in Table 3.

Table 3
Effect of germination duration on the protein complex of quinoa grain (seeds)

Substances	Mass fraction of substances in grain (seeds), in % in air-dry matter				
	original	*sprouted, after, an hour*			*dried*
		24	*72*	*120*	
Crude protein, including:	16,38	16,38	16,38	16,57	16,46
Protein	14,66	14,66	14,22	14,13	13,91
non-protein nitrogen	1,72	1,72	2,16	2,44	2,55
non-protein nitrogen, in % to protein	10,50	10,50	13,19	14,72	15,50
Substances:					
Water-soluble	2,26	2,65	3,10	4,78	4,61
Salt-soluble	1,07	1,44	1,56	1,87	1,79
Alkali-soluble	6,03	4,32	4,01	3,75	3,82
alcohol-soluble	2,60	2,79	2,58	2,07	2,10
non-recoverable balance	2,70	3,46	2,97	1,66	1,59
The ratio of easily and hardly soluble protein fractions	0,29:1,0	0,39:1,0	0,48:1,0	0,89:1,0	0,85:1,0

It follows from the data in Table 3 that germination leads to a change in individual protein fractions. Thus, it was found that the content of water - and salt - soluble fractions in the grain naturally increases due to alkali-and alcohol-soluble, as well as non-recoverable residue. The ratio of easily - and hardly-soluble protein fractions improves, which makes the protein more accessible for assimilation.

It was found that the content of total sugars during germination increased by an average of 7.8 %. This is due to the hydrolysis of the main reserve substance of starch and the use of sugars as the initial source of energy for growing organs in the germinating grain (Table 4).

Table 4
Effect of germination duration on the carbohydrate complex of quinoa grain (seeds)

Substances	Mass fraction of substances in grain (seeds), in % in air-dry matter				
	original	*sprouted, after, an hour*			*Dried*
		24	*72*	*120*	
Nitrogen-free extractive substances (BEV), including:	65,40	63,50	62,10	60,42	60,26
Starch	44,81	39,92	32,84	25,40	23,95
dextrins (including free sugars)	19,19	20,57	25,84	31,01	32,49
free sugars	6,85	7,16	7,80	10,32	11,15
non-starch polysaccharides	1,40	3,01	3,42	4,01	3,83
Raw fiber	7,96	8,54	9,80	11,32	11,34

It was found that the starch content during the germination of grain (seeds) decreased from 2.9 to 7.6%, while the content of free sugars increased from 4.5 to 50.6%, non – starch polysaccharides - by 2.1...2.9 times, crude fiber-from 7.3 to 42.2%. This is due to the hydrolysis of the main reserve substance of starch and the use of sugars as the initial source of energy for growing organs in the germinating grain.

It should be noted that representatives of the Amaranth family, which includes quinoa, also contain anti-nutritional substances: trypsin inhibitor and tannins, which are present in small amounts (0.06%) and are effectively inactivated during moisture-heat treatment.

CONCLUSION

The obtained data indicate the high biological value and food safety of quinoa and amaranth seeds (grain) zoned in various agroecological zones of Uzbekistan, as well as the feasibility and prospects of their use in the production of mixed feeds. It is proved that the direction of increasing the productivity of birds is promising when using sprouted quinoa grains (seeds) in their diet, which contains all the ingredients necessary to maintain optimal metabolism: proteins, carbohydrates, fats, macro-and microelements, etc.

Thus, the inclusion of sprouted grain in the production of compound feeds is a promising and relevant scientific direction of research that has practical significance.. This determines the implementation of the priority directions of the state's development strategy in the field of ensuring food security of the republic, the economic component in terms of reducing the cost of production through the use of regional plant resources.

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