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RATIONAL USE OF OIL CROPS WASTE IN FEED PRODUCTION

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Currently, at the stage of the country's economic development, in order for the agricultural sector to become profitable, competitive, and also ensure long-term independence, it must be productive. In this regard, it is necessary to use agricultural waste to increase productivity and the raw material base of feed production and improve quality. Such agricultural waste includes post–harvest waste from oilseeds, which are rich in minerals, micro-macronutrients, protein, fat, fiber and vitamins. The use of post-harvest waste from oilseeds in the production of compound feeds is economically feasible. However, fulfilling this condition in industrial livestock farming requires large financial resources, which are not always recouped by the products produced. The way out of this situation is to replace expensive components with plant energy-protein components. During the study, a recipe for compound feeds with the introduction of post-harvest waste of oil crops was developed. Also, quality indicators such as crude protein, digestible protein, fat, fiber, and feed unit were studied. It was found that when introducing feed flour from post-harvest waste in the amount of sunflower -5%, safflower -2% into compound feeds, the quality indicators did not show any visible changes. With an increase in the rate of introduction of feed flour into compound feeds, the quality indicators increased. Thus, the introduction of waste-free technologies for the production of oilseeds with the development of products suitable for inclusion in compound feed will significantly expand the raw material base for compound feed production.

Keywords: feed, formulation, nutritional value, oilseed waste.

РАЦИОНАЛЬНОЕ ИСПОЛЬЗОВАНИЕ ОТХОДОВ МАСЛИЧНЫХ КУЛЬТУР В КОРМОПРОИЗВОДСТВЕ

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В настоящее время на этапе экономического развития страны, чтобы сельскохозяйственное направление стало рентабельным, конкурентоспособным, а также обеспечиволо продолственную независимость, оно должно быть продуктивным. В связи с этим для повышения продуктивности и сырьевой базы комбикормового производства, а также для повышения качества необходимо использовать сельскохозяйственные отходы. К таким сельскохояйственным отходам относятся послеуборочные отходы масличных культур, которые богаты минералами, микро, макроэлементами, белками, жирами, клетчаткой и витаминами. Использование послеуборочных отходов масличных культур в производстве комбикормов экономически целесообразно. В ходе исследований разработан рецепт комбикормов с вводом послеуборочных отходов масличных культур. А также исследованы качественные показатели, как сырой протеин, переваримый протеин, жир, клетчатка, кормовая единица. Установлено что при вводе в комбикорма кормовую муку из послеуборочных отходов в количестве подсолнечника -5%, сафлора -2% качественные показатели практически не изменились При увеличении нормы ввода кормовой муки в комбикорма качественные показатели повысились. Таким образом, внедрение безотходных технологий производства масличных культур с выработкой пригодных для ввода в комбикорма отходов позволит значительно расширить сырьевую базу комбикормового производства.

Ключевые слова: корма, рецептура, питательность, отходы масличных культур.

ЖЕМ ӨНДІРУДЕ МАЙЛЫ ДАҚЫЛДАР ҚАЛДЫҚТАРЫН ҰТЫМДЫ ПАЙДАЛАНУ

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Қазіргі уақытта елдің экономикалық даму кезеңінде ауылшаруашылық бағыты үнемді, бәсекеге қабілетті болуы үшін, сондай-ақ ұзақ мерзімді тәуелсіздікті қамтамасыз ету үшін ол өнімді болуы керек. Осыған байланысты құрама жем өндірісінің өнімділігі мен шикізат базасын арттыру және сапасын арттыру үшін ауыл шаруашылығы қалдықтарын пайдалану қажет. Мұндай ауылшаруашылық қалдықтарына минералдарға, микро –макроэлементтерге, ақуызға, майға, талшықтарға және дәрумендерге бай майлы дақылдардың егін жинаудан кейінгі қалдықтары жатады. Майлы дақылдардың егін жинаудан кейінгі қалдықтарын құрама жем өндірісінде пайдалану экономикалық орынды. Зерттеу барысында майлы дақылдардың егін жинаудан кейінгі қалдықтарын енгізумен құрама жем рецепті әзірленді. Сондай-ақ, шикі ақуыз, қорытылатын ақуыз, май, талшық, Жем бірлігі сияқты сапалық көрсеткіштер зерттелді. Құрама жемге егін жинаудан кейінгі қалдықтардан жемдік ұнды күнбағыс мөлшерінде -5%, мақсары -2% сапалық көрсеткіштерге енгізгенде көрінетін өзгерістер көрсетілмегені анықталды. Азықтық ұнды құрама жемге енгізу нормасы ұлғайған кезде сапалық көрсеткіштер артты. Осылайша, құрама жемге енгізуге жарамды май дақылдарын өндірудің қалдықсыз технологияларын енгізу құрама жем өндірісінің шикізат базасын едәуір кеңейтуге мүмкіндік береді.

Негізгі сөздер: құрам жем, рецепт, құңарлығы, майлы дақылдар қалдығы.

Introduction

Kazakhstan has enormous potential in this sector, as there are plenty of territories for the development of this sector [1].

Forage production, as the largest and most multifunctional branch of agriculture, plays a vital role not only in livestock farming, but also in the management of agricultural lands, ensuring their productivity, sustainability and profitability. It links together crop production, livestock farming and ecology, rational use of natural resources and environmental protection [2, 3].

Increasing the production of livestock products is one of the main tasks of Kazakhstan for the next decade. The main thing in its implementation is the organization of industrial livestock farming based on strengthening the forage base and compound feed. The creation of a reliable forage base, and first of all the development of compound feed production in the country is one of the main conditions for increasing the production of livestock products.

The use of complete compound feeds leads to savings in scarce protein feeds and to better absorption of nutrients in diets, and makes it possible to mechanize the main processes of feed distribution. The production of compound feeds in livestock farms allows for more efficient use of local feed resources, as well as the inclusion of various secondary feed resources in the animal diet [4].

In Kazakhstan, due to insufficient and inefficient utilization of secondary raw materials in the processing and food industries, more than 0.5 million tons of vegetable protein are lost each year [5]. An urgent task of the feed industry is the development of resource-saving technologies for the production of feed for farm animals using waste from the food and processing industry containing biologically active substances in order to increase the productivity of farm animals, improving the quality of finished products and reducing their cost [6].

Currently, in all regions of the country there are and are constantly accumulating large reserves of little-used or completely unused waste from agricultural processing enterprises, grain processing, flour milling, as well as waste from livestock and poultry farming. Not bringing obvious benefits, they are at best used in their native form as cattle feed, but are often simply thrown away. However, this represents a significant reserve for supplementing raw materials used in compound feed production. These reserves include waste from oilseed crops, as oil crops are important agricultural commodities. On the global market, several oilseeds dominate, including rapeseed, canola, sunflower, peanut, and soybeans [7].

Oilseeds in the Republic of Kazakhstan are the main source of vegetable oils, and in recent years, oilseeds have served as export products. The

diversity of natural and climatic conditions of the republic allows for the cultivation of a fairly wide range of oilseeds that can successfully compete in international markets. This applies to both traditional crops for Kazakhstan - sunflower, cotton, flax, and soybeans, rapeseed, safflower and other crops, which currently occupy small areas but are actively developing.

The species composition of oil plants grown in the Republic of Kazakhstan is quite diverse. While 10–20 years ago their cultivation seemed almost exotic against the backdrop of dominant wheat production, today the acreage of oilseed crops has been steadily increasing. This trend highlights the growing importance of oilseed cultivation as a priority direction in crop production. Oilseeds are second only to grains in the human diet and are widely used in livestock farming and for industrial purposes. [8, 9, 10].

Oilseed crops generate various by-products and a large amount of waste in the agro-industrial sector. In the EU, they account for approximately 12.7 million tons of food waste, of which about 10 million tons (80%) arise during processing and food production stages [11, 12]. As is known, according to literature data, the amount of waste from oilseeds today reaches about 42.8 thousand tons. per year.

To ensure a stable ecological situation of the environment, more rational and economic use of material resources in the national economy, complex processing of raw materials, low-waste, waste-free technology is necessary [13].

The aim of the research is to develop the recipe and nutritional value of compound feeds based on oilseed waste, which will improve the quality of finished products and reduce their cost.

Materials and research methods

The development of the recipes was carried out at the educational and scientific center of compound feed production of the Almaty Technological University. The analyses of the study were carried out at the Kazakh Research Institute of Processing and Food Industry, and the Kazakh Research Institute of Animal Husbandry and Forage Production.

The object of the study was compound feed with the addition of feed meal from post-harvest waste of oil crops (sunflower, safflower).

The subject of the study is compound feed for dairy cows using feed meal from post-harvest waste of sunflower and safflower.

Technological parameters of feeds were determined according to GOST 51899-2002 Granulated compound feeds. General technological conditions [14].

The qualitative indicators of compound feed were determined according to GOST 32040-2012 Feed, Compound feed, Feed raw materials. Method for determining the content of crude protein, crude fiber, crude fat and moisture using near infrared spectroscopy [15].

The physical and mechanical properties of compound feeds were determined in laboratory conditions in accordance with current GOSTs.

Results and discussion

After harvesting sunflower and safflower, waste remains, which is an additional reserve for livestock farming. The dry matter content in the waste is up to 20-40%, it is unstable during storage, quickly sours, and is subject to spoilage [14]. The most common and effective method is drying the waste. Waste oil crops were dried at a temperature of 70-75^{0}C for 15-20 minutes. After drying, feed flour was obtained by grinding.

Table 1. Chemical composition of feed flour

Object of study	Mass fraction of protein, %	Mass fraction of fat, %	Mass fraction of fiber, %	Ash content, %
Sunflower meal for animal feed	5.6	3.4	0.7	18.0
Safflower meal for animal feed	6.0	2.4	1.4	4.3

As can be seen from Table 1, the chemical composition of feed flour obtained from post-harvest waste of oilseeds is not inferior to grain raw materials in terms of basic nutritional values.

When studying the physical-chemical properties of feed flour produced from post-harvest waste of oilseeds, the following results were obtained, which are presented in Table 2.

Table 2. Physicochemical parameters of feed flour

Name	Bulk density, g/l	Angle of natural slope, deg
Feed meal from sunflower waste	160	45
Safflower Waste Feed Meal	180	47

The bulk density of experimental batches of compound feed was determined on a purka [16]. The results of the study showed that the bulk density of sunflower post-harvest waste meal was 160 g/l, and safflower post-harvest waste meal was 180 g/l. An important indicator of the technological effectiveness of the finished product is the angle of repose; if the angle of repose does not exceed 47 degrees, the product is considered technologically good.

The study of the chemical composition and physical-chemical properties of feed flour from post-harvest waste of oilseeds confirms its importance as a valuable raw material for the production of compound feeds. When making experimental recipes, wheat was replaced with feed flour in accordance with the rules of interchangeability of raw materials.

The replacement of grain raw materials in compound feeds with feed flour seems rational and allows us to effectively solve a number of significant tasks. The introduction of alternative components such as feed flour ensures a reduction in the proportion of valuable grain raw materials in compound feeds while maintaining quality indicators.

Instead of wheat, sunflower waste meal was added to the compound feed in the amount of 5, 7, 10%. Safflower waste meal was introduced in the amount of 2, 3, 5%.

As a result of the study, a recipe for compound feeds was developed in which the grain raw material was replaced with feed flour obtained from post-harvest waste of oil crops. The control variant is the recipe for compound feed KK 61 for dairy cows. The obtained data on the main nutritional indicators were compared with the data of the control recipe.

Table 3. Recipe for compound feed for dairy cows

Components	Control	Experienced recipes, %		
		1	2	3
Wheat	21.0	17.0	14.0	11.0
Corn	30.0	30.0	30.0	30.0
Barley	10.0	10.0	10.0	10.0
Wheat bran	16.0	16.0	16.0	16.0
Corn feed	10.0	10.0	10.0	10.0
Sunflower cake	8.0	5.0	5.0	5.0
Feed phosphate	2.0	2.0	2.0	2.0
Chalk feed	1.0	1.0	1.0	1.0
Table salt	1.0	1.0	1.0	1.0
Premix	1.0	1.0	1.0	1.0
Sunflower Waste Flour	-	5	7	10
Safflower Waste Flour	-	2	3	5
Total	100,0	100,0	100,0	100,0
Dry protein, %	17.50	22.64	23.67	23.43
Digestible protein, g	124.27	160.2	168.03	166.35
Crude fat, %	3.56	3.06	3.22	3.04
Crude fiber, %	4.34	3.87	3.48	3.50
Sugar, %	1.94	2.08	2.11	2.01
Starch, %	30.82	29.0	29.74	30.67
Calcium, %	0.84	0.86	0.87	0.92
Phosphorus, %	0.30	0.28	0.29	0.31
Nitrogen-free extractive substances, %	61.21	56,56	55.45	55,53
Feed unit, kg	1.22	1.24	1.24	1.23

The analysis of the obtained results in Table 3 shows that the compound feed contains a significant amount of protein, minerals, a relatively small amount of fiber and fat, and it also meets regulatory requirements in terms of organoleptic indicators.

According to the results of the study, the experimental version No. 2 showed better quality characteristics compared to the control one. Crude protein is the most important factor limiting the level of productivity of animals. It was found that a deficiency of only 1% of feed protein in the diet of animals leads to an overspending of 2-3.5% of feed and an increase in cost by 4-5% [17]. The dry protein content in the ombifer in experiments No. 2 is higher than in the other variants. It is -23.67% in experiment No. 2, which is 30-35% higher than in the control variant. The digestible protein is increased by 30-35% compared to the control variant, in the control it was -124.27 g, and in experiment No. 2 - 168.03 g. The crude fiber in the experimental variants is lower by 10-11% compared to the control variant. The feed unit is almost the same in all variants.

Conclusions

The study showed that the quality indicators of compound feeds did not have a special effect when replacing wheat with feed flour in the amount of 5% sunflower waste and 2% safflower. When increasing the input rate of feed flour from sunflower waste by 7.10% and 3.5% safflower waste, some quality indicators increased.

During the study, a recipe for compound feed was developed with the introduction of post-harvest waste from oilseed crops instead of part of the wheat for dairy cows.

Thus, the volume of feed production, its quality and cost are currently key factors limiting the accelerated development of domestic animal husbandry.

The use of waste-free technologies for processing oilseeds, providing for the production of components for compound feeds, provides an expansion of the feed industry's raw material base, increasing animal productivity and producing environmentally friendly products.

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