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RESULTS OF DETERMINING THE TECHNOLOGICAL MODE OF DRYING ALFARM AND PREPARING COMPOSITE FEED USING SOLAR COLLECTORS

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Protein, Drying Temperature, Solar Radiation, Moisture, Drying Time.

ABSTRACT

Alfalfa is known as the king of nutrition due to its digestibility, which contains all kinds of substances. One kilogram of alfalfa grass at flowering yields 0.6 kg of nutrient units and 80 g of digestible protein, and 0.9-1.0 kg of nutrient units and 160 g of protein per kilogram of grass meal. The nutritional value of nutrient-dense food directly depends on the method of its preparation. 90% of nutritional units and 80% of absorbable protein are fully utilized by preparing vitamin green fodder according to the technology. In the article, the parameters of alfalfa drying equipment, such as drying temperature, drying time, and cutting length, are studied in connection with the technology of vitamin green fodder preparation, and the mathematical model of dependence and optimal values are determined.

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Introduction.

In order to produce good quality hay from haylage, it is necessary to reduce the moisture content to 18-22%. The quality of the grass depends to a large extent on how quickly the free and physico-chemically bound water evaporates during grass preparation. When green plants are dried on the ground in the usual way, the loss of carotene in 1 kg of feed increases to 80...100 mg.

The researchers found that when freshly harvested green plants are artificially dried (using solar heat accumulators) and prepared as grass flour, its nutritional value is slightly lost, and its nutritional value is almost 2 times higher than when dried on the ground by traditional methods [2]. Mongolia has abundant renewable energy resources, and 200-260 days out of 365 days a year are clear [3].

Исследовали кинетику сорбции паров жидких сред на весах Мак-Бона с кварциевой спиралью и определяли молекулярные массы полимеров вискозиметрическим методом.

Therefore, a model of a drying device using solar energy was designed, and drying technology experiments and research were carried out. The purpose of determining the amount of protein content of green fodder plants depending on the drying temperature, drying time, and length of cutting of the plant was set.

Experimental design.

In this research work, the raw materials for preparing vitamin feed from green plants were selected, the protein content, physical and mechanical properties of the selected plants were determined, and the operating mode of the artificial drying device was optimized and mathematically processed.

Fig. 1 shows the device used for production tests to reduce the amount of moisture of green fodder plants.

The amount of protein in vitamin feed (C) was determined depending on three factors, such as the drying temperature (t), the drying time (T), and the length of cutting alfalfa (l).

Figure 1. The object of the production test

The test black box is shown below (Fig. 2).

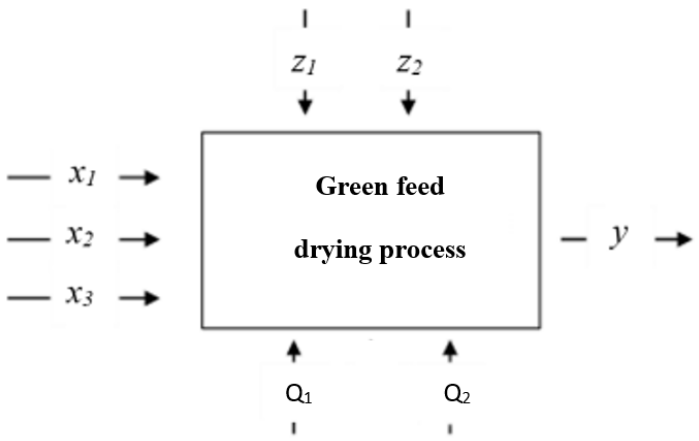

Figure 2. Black box for planned testing.

Of this:
Controlled factors:
x_1 – the drying temperature – t, $[deg]$;
x_2 – the drying time – T, $[hours]$;
x_3 – the length of cutting alfalfa –l, $[mm]$;
Controllable but unmanaged factors:
Q_1 – nutrient value of alfalfa;
Q_2 – the moisture of alfalfa;
Unmanaged factors:
z_1 – ambient air humidity;
z_2. -solar radiation.

The experimental plan consists of a three-factored (n = 3) factorial design with five levels. Levels of variation and codes of the independent variables of x1, x2, and x3 for the rate of scarification are presented in Table 1.

Table 1. Levels and codes of the independent variables of t, T and l.

		1.68	1	0	1	1.68	Δ
The drying temperature – t, $[deg]$	x_1	33.18	0	0	60	6.81	3.18
The drying time – T, $[hours]$	x_2	5.31	6	7	8	8.68	1
The length of cutting alfalfa –l, $[mm]$	x_3	6.59	10	15	20	23.41	0.5

Table 2. Real and coded values for independent variables the drying temperature (x_1), the drying time (x_2), and the length of cutting (x_3) the amount of protein in vitamin feed (y).

	t, $[deg]$	T, $[hours]$	l, $[mm]$	t, $[deg]$	T, $[hours]$	l, $[mm]$	C
	x_1	x_2	x_3	x_1	x_2	x_3	y
1	2	3	4	5	6	7	8
1	1	1	1	40	6	10	17.15
2	1	1	-1	60	6	10	14.24
3	1	-1	1	40	8	10	18.86
4	1	-1	-1	60	8	10	17.44

Table 2. Continuation.

1	2	3	4	5	6	7	8
5	-1	1	1	40	6	20	11.69
6	-1	1	-1	60	6	20	15.41
7	-1	-1	1	40	8	20	13.65
8	-1	-1	-1	60	8	20	15.45
9	1.68	0	0	33.18	7	15	15.53
10	-1.68	0	0	66.81	7	15	16.04
11	0	1.68	0	50	5.31	15	12.98
12	0	-1.68	0	50	8.68	15	16.91
13	0	0	1.68	50	7	6.59	15.06
14	0	0	-1.68	50	7	23.41	14.94
15	0	0	0	50	7	15	17.79
16	0	0	0	50	7	15	16.47
17	0	0	0	50	7	15	16.27
18	0	0	0	50	7	15	15.33
19	0	0	0	50	7	15	14.76
20	0	0	0	50	7	15	16.52

Optimization parameters:
y – the amount of protein in vitamin feed, C; $y = f(x_1, x_2, x_3) \rightarrow max$.

Results.

According to the methodology of the experiment, the experiment was conducted to optimize the parameters of the technology for the preparation of vitamin green fodder. The dependent variable was determined using rotatable experimental design. [1] The basic level of the input factors was derived from experiments using preliminary laboratory equipment and the results of researchers. The drying temperature was 50 degrees, the drying time was 7 hours, and the alfalfa cutting length was 15 mm [5], [8], [9],[10]. At these values, alfalfa protein quality parameters showed the greatest variation.

When checking that the numerical values of the measurements follow the normal distribution law by Shapiro and Wilka's W criteria, the calculated value W_T=138.57 satisfied the condition that the table value W_X=0.905 is greater.

When checking the homogeneity of dispersion by Cochran's G criterion, the calculated value G_T=0.157 satisfies the condition that the table value G_X=0.270 is lower.

The significance of the coefficients of the regression equation is checked by the Student's test, and the correctness of the equation is checked by the Fisher test. The calculated value of the criterion is F_T=1.91, and the condition $F_T < F_X$ (F_X=2.25) is met, so the mathematical model is created as follows.

$$y=376.24-7.52x_1+1.97x_2-24.55x_3+0.49x_1x_3 \quad (1)$$

The amount of protein in vitamin feed=376.24-7.52(t)+1.97(T)-24.55(l)+0.49(t)(l) (2)

Using the mathematical model (2) to determine the optimization value by finding the extremum of the factor of 3, the optimal values are X_1^0=56 degree, X_2^0=8 hours, X_3^0=15.5 cm protein content is $Y_{max}(X_1^0, X_2^0, X_3^0)$=16.4%.

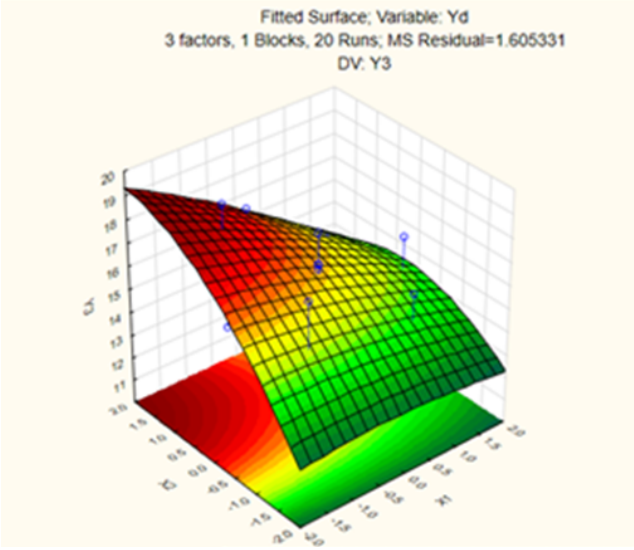

Figure 3. 3-D plots fort the amount of protein in vitamin feed as the drying temperature and the drying time.

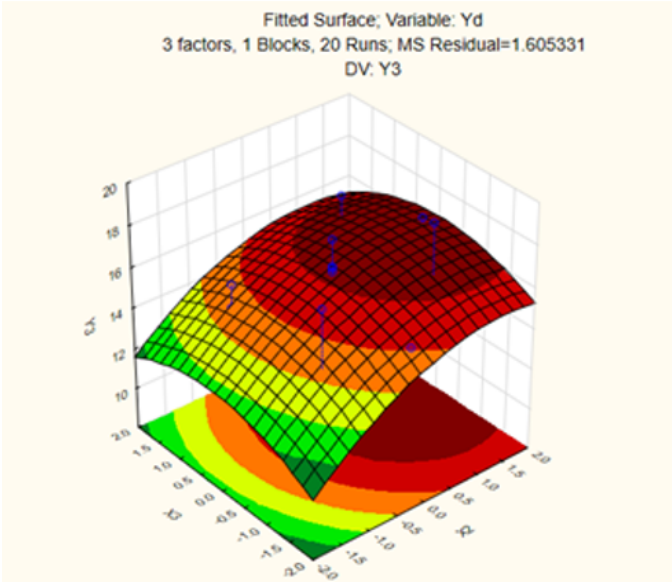

Figure 4. 3-D plots fort the amount of protein in vitamin feed as the drying time and the length of cutting.

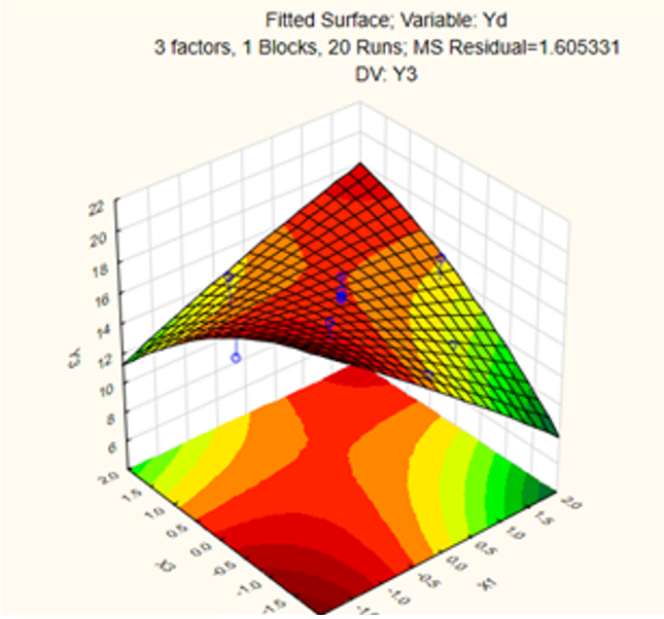

Figure 5. 3-D plots fort the amount of protein in vitamin feed as the drying temperature and the length of cutting.

Discussion.

Haiqing Wu, a Chinese researcher, artificially dried alfalfa and studied the changes in nutrient quality, and found that the protein content was 12-18% [10]. American researcher Rebecca Rose Milczarek's made a mathematical model for drying food and fodder plants using solar energy and optimized research [7]. Researcher Ahmet Yusuf Sengul of Turkey artificially dried alfalfa showed a protein content of 18-21% [11], [12]. Mongolian researchers Ch. Sodnomtseren and D. Baatar studied the preparation of vitamin feed and found that alfalfa protein content was 12-18% during flowering [2] [5]. Using solar energy to dry alfalfa in a greenhouse under the conditions of Mongolia, the protein content was determined to be 16.48%, which is close to the results of researchers from other countries.

Conclusion.

1. The mathematical model of the degree of peeling of buckwheat is as follows. It includes: The amount of protein in vitamin feed=376.24-7.52(t)+1.97(T)-24.55(l)+0.49(t)(l).
2. The protein content of alfalfa dried experimentally is 16.48%, which is close to the results determined by researchers.
3. The maximum value of amount of protein in vitamin feed is 16.4 % when the drying temperature – 56 degree, the drying time -8 hours, and the length of cutting -15.5 cm.

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