THE OPTIMAL RATIO OF CORN AND VEGETABLE ROOTS IN EXTRUDED FORAGE

SHAPOVALENKO O.I., dr.t.s., professor
National University of Food Technologies
ULYANYCH I.F., graduate
Uman National University of Horticulture

The results of investigation to study the effect on quality parameters of maize extrudate depending on the content of vegetable ingredients such as beets and carrots dinner table. It is shown that the physical and technological properties during extrusion affects the concentration of additives. Adding vegetables to corn reduces the specific power consumption for extruding process. The optimum ratio of components.

Extruder, forage, corn, beet, carrot, moisture content, bulk density, swelling, angle of repose, coefficient of expansion.

Statement of the problem. Today for ecologically clean meat, better growth and development, and to improve animal productivity professionals are increasingly turning to the use of natural feed additives in the feed. At the same time, our country is constantly accumulating large amounts of raw materials, which is not used in the feed industry. Therefore, the transition to alternative feed production technology is one of the priorities of increasing food supply and reducing the cost of its production [1,2,5].

Recently, there is lack of modern technology, industrial raw materials like natural feed additive for fattening animals [2,3].

Improving the quality of animal feed products and to improve the diet of animals depends on the introduction of new types of fodder plant material containing in the structure a balanced complex of proteins, lipids, amino acids, organic acids, minerals, vitamins that play an additional role acidulent natural and have high nutritional and feed properties, as indicated in their research leading scientists V.A .Afanasiev [5], B.V. Egorov [6], A.P. Levitsky [1,2], A.N. Ostrykov [4].

Purpose of the study – to improve the feed value of corn from the enrichment vegetable components with preservation of physical and technological properties of extrudates.

Object of study – raw grain (maize) and vegetable components (beet, carrot).

Research Methodology. The study was conducted at the Department of Technology of storage and processing of grain Uman National University of Fruit.

For extrusion product prototypes and experimental research, the laboratory extruder one auger KECH-1.

Specifications extruder one auger KECH-1

Productivity, kg / h.	20-40
Rated power output (AYRM100L6U2), kW	3.7
Power factor, $cos\varphi$	0,74
Turnover rate shaft electric, rev. / pass	945
Turnover rate auger, rev. / pass.	610
Nominal torque on the shaft of the auger,	31 Nm
Diameter the auger,	35 mm
The ratio of length to diameter auger	5

Short-extrusion method for the simultaneous effects of intensive mechanical stress and high temperature (120-170°C) obtained extrusion products made from corn and vegetable components in concentrations of 2,5 %, 5,0 %, 10,0 %, 15,0 %, 22,5 %.

The process was a follows. The extruder heated to a temperature of 160°C, screw speed was 610 rev./pass. On receiving extruder hopper lodged previously prepared mixture of whole grain corn and chopped vegetables (thickness – 1–2 mm, length – 4–10 mm). The value of feed mixtures remained constant. More information, the product got in to the zone boot, where seized screw mix compacting, layering and gouging through the annular gap. Cross-sectional area was constant and amounted to 19,5 mm^2 (equivalent to a matrix of 5 mm diameter).

Extruded samples was crushed to a particle size of 6–12 mm. We determined the moisture, volumetric mass, coefficients of expansion and swelling, the angle of repose. These parameters is characterizes the technological quality of extrudate.

Results of Studies. The resulting mixture of crushed corn with vegetable ingredients and outgoing samples were evaluated by a set of physical and technological parameters. They allow to detecting structural changes in grain mixtures that occur during the extrusion process and evaluate the quality of the resulting product. Found, that during extrusion significantly was reduced moisture products (table 1).

1**The change weight particle moisture during extrusion depending on the composition of the vegetable components**

Mixture corn with vegetable ingredients			Beet			Carrot		
			weight particle moisture,%	to the initial value, %	± to the initial value, %	weight particle moisture,%	to the initial value, %	± to the initial value, %
Вміст овочевого компоненту, %	0 (К)*	original	14,3	100		14,3	100	
		extruded	9,8	68,5	-31,5	9,8	68,5	-31,5
	2,5	original	16,2	100		16,1	100	
		extruded	11,6	71,6	-28,4	11,1	68,9	-31,1
	5,0	original	18,2	100		18,0	100	
		extruded	13,4	73,6	-26,4	12,8	71,1	-28,9
	10,0	original	22,1	100		21,6	100	
		extruded	16,0	72,3	-27,6	15,8	73,2	-26,9
	15,0	original	26,0	100		25,3	100	
		extruded	18,5	71,2	-28,9	18,1	68,8	-31,2
	22,5	original	31,8	100		30,8	100	
		extruded	23,2	73,0	-27,0	22,8	74,0	-26,0

*(К) – control

Analysisof evidenceshowed,thaton one's own ofvegetable species component and youconcentrationweight particle moistureafter extrusion was decreased at the average on 26,0–31,5 %. The greatest losses of moisture was received in the grain sample without the addition of vegetable components, which weight particle moisture amounted 68,5 %to the initial value, and the difference reached 31,5 %. Addition to the mix shredded beet in different concentrations contributed to increasing weight particle moisture in the original production on 2–17,5 % and carrot – slightly lower – 1,8–16,5 %.

Thus, during extrusion processing of corn with vegetable mixture components is significantly reduced moisture content, which contributes to further its conservation and sustainable use for food.

Determination of the main physical parameters mixture of corn with vegetable ingredients, such as bulk density, swelling, angle of repose, showed that the extrusion

process is a change of parameters depending on the concentration of the components (Table 2).

2**Physical parameters mixture of corn with vegetable ingredients depending of the concentration**

Mixture corn with vegetable ingredients			Bulk density, kg/m3	Swelling, ml/g	The angle of repose, degrees	Coefficient of expansion
Content beet,%	0 (C)*	original	637,1	4,17	32,0	–
		extruded	138,4	8,53	41,4	3,23
	2,5	original	654,9	4,13	34,6	–
		extruded	147,7	8,43	41,3	3,06
	5,0	original	668,7	4,07	36,7	–
		extruded	156,4	8,23	42,7	2,63
	10,0	original	692,4	3,98	39,8	–
		extruded	198,7	7,40	43,2	1,73
	15,0	original	732,1	3,89	41,5	–
		extruded	242,8	6,07	43,8	1,53
	22,5	original	778,7	3,74	46,4	–
		extruded	272,1	4,43	45,4	1,02
Content carrots,%	0 (C)*	original	637,1	4,17	32,0	–
		extruded	138,4	8,53	41,4	3,23
	2,5	original	667,7	4,12	34,6	–
		extruded	145,3	8,49	41,5	3,19
	5,0	original	700,4	4,06	36,2	–
		extruded	151,5	8,43	42,6	2,28
	10,0	original	700,4	3,92	39,3	–
		extruded	194,0	7,77	41,2	1,65
	15,0	original	733,1	3,83	42,4	–
		extruded	245,2	6,65	43,9	1,34
	22,5	original	774,7	3,73	45,9	–
		extruded	262,7	4,56	45,2	1,05

(C)* – control

Since macromolecules extrudates compared loosely packed between them may form a cavity into which water penetrates, it causes an increase in the size and degree of swelling. Analysis of the data table showed that extruded corn with vegetable root crops degree of swelling is 8,53 ml/g, while the rough 4,17 ml/g. Adding to forage from maize root vegetables in different concentrations reduced the swelling mixture. Thus, concentrations of 2,5 % depending on the degree of swelling component was 8,43–8,49 ml/g.

Increased content of vegetable roots to 10 % led to a decrease in 7,40–7,77%, but increased to 15 % caused a decrease in the degree of swelling to 6,07–6,65 %. Further increase of concentration of the vegetable components in foodmixture to 22,5 % led to a decrease in swelling, which reached a level of 4,43–4,56%.

So swelling mixture cornwithvegetableingredients depending of theycontens showedthat with increasing content of the added component decreases swelling extruded product, that show decreasesability to mix with high concentrations of components absorb water.

Next, determine the volumetric mass of the mixture. These result indicate that the increase of vegetable components causes an increase in bulk density forage in the feedstock from 637,1 to 778,7 kg/m3 and extruded – from 135,6 to 272,1 kg/m3.

The angle of repose of the feedstock reaches the level of 32 degrees. With the increase of vegetable components it reached 46 degrees. The process of extrusion rate boosted to 1-9 degrees. For vegetable component content 22,5% indicators crude mixture and final extrudate aligned and angle of repose was 45-46 degrees.

After product exit from the matrix through significant differences of temperature and pressure is sharp release of moisture. This leads to the formation of highly porous structure and a significant increase in the transverse size of the extrudate. The corresponding process is characterized by the degree of increase in the volume of product that is the primary measure depends on the content of starch. Expansion ratio of extrudates of maize was 3,17 and decreased by further increasing the concentration of vegetables. The lowest figure was for making vegetable component at a concentration of 22,5% and amounted to 1,02–1,05.

Performance is determined by weighing the amount of the finished extrudate over time.The best performance was in the concentration of 2,5-5,0% vegetable components.This is due to moisture content in vegetables, which in moderate concentrations (16-18%) improves the flow process. But further increase in moisture content leads to poor transport auger fluid material.

3**Technological extrusion process parameters**

Exponent		Concentration vegetable component, %					
		0,00%	2,50%	5,00%	10,00%	15,00%	22,50%
Productivity, kg / h	Б	26,5	27,6	26,8	22,3	19,6	18,2
	С		26,7	25,4	21,8	18,6	17,8
The load motor, A	Б	6,4	6,1	5,4	4,9	4,6	4,8
	С		6,3	5,5	5,0	4,7	4,9
Power consumption, KW	Б	3,1	3,0	2,6	2,4	2,2	2,3
	С		3,1	2,7	2,4	2,3	2,4
Specific electricity consumption, kW / h t	Б	117,6	107,7	98,1	107,0	114,4	128,5
	С		115,0	105,6	111,7	123,1	133,9

Б –beet
С – carrot

Specific electricity consumption depend on the performance and power consumption equipment. While linear load current strength in the circle is proportional to the instantaneous value, and the whole power consumption is active. Active power calculated by the formula:

$$P = \sqrt{3} \cdot U_л \cdot I_л \cdot cos\varphi, \text{ (W)}$$

where $U_л$·– linear voltage, $I_л$– line current; cosφ – power factor of the motor.

The results show that power consumption is reduced by increasing the concentration of vegetable component. The lowest figure is 2,2–2,3 KW by adding 15% vegetables.

Specific electricity consumption – the ratio of power consumption to performance. Extruding maize requires more power than a mixture of vegetables. Specific electricity consumption for the lowest concentration of 5–10% vegetable component. But the most energy-consuming mixtures containing vegetables 22,5%.

Conclusions. Found that adding vegetables to corn reduces the unit cost of electricity extrusion process. The optimum concentration of vegetable component is 5-10%. In this concentration, a decrease energy consumption by 15% and improve physical and technological parameters.

Also during extrusion processing of corn with vegetable mixture components is significantly reduced moisture content, which contributes to further its conservation and sustainable use for food.

References:

1. Levytskyy A.P Kormovaya values cabbage vyzhymky / A.P.Levytskyy, V.S. Myronov, Y.V. Hodakov. – Grain and feed products. – № 4 (44). – 2011. – S. 29-30.

2. Levitsky A.P. Effect of extrusion on the feeding value of flour from grape seeds and leaves / A.P. Levitsky, V.S. Mironov, I.V. Hodakov that in. – Zernovi produkti i kombikormi. – № 1 (45). – 2012. – S. 21-22.

3. Kochetova A.A. Effect on Efficiency podkyslyteley ekstrudirovanija grain raw materials / A.A. Kochetova, E.E.Voetskaya, A.V.Makrynskaya, A.Y.Sharova / / Cereal foods and animal feed. – № 1. – 2011. – S. 33-38.

4. Ostrykov A.N. Extrusion technology in pyschevoy / A.N. Ostrykov, O. Abramov, A.S. Rudometkyn. – SPb.: HYORD, 2004. – 288 s.

5. Afanasyev V.A. Theory and practice spetsyalnoy Monitor grain components in the technology kombykormov. – Voronezh: Voronezhskyy State University, 2002. – 296 s.

6. Egorov B.V. Technology of production of premixes / B.V Egorov, A.I Shapovalenko, A.V Makarynska. – Tutorial. – K: Center of Literature, 2007. – 288 s.

7. Chebotarev A.N. Technology flour krupы and kombykormov / A.N Chebotarev, A. Shazzo, J.F Martыnenko. – Moscow: YKTS "March", Rostov n / D: Yzdatelskyy Centre "Marta", 2004. – 688 s.

8. Zeveke G.V Fundamentals of theory tsepey: Textbook. for high schools / H.V. Zeveke, P.A Yonkyn, A.V Netushyl, S. Fears. – 5th ed., Rev. – Moscow: Energoatomizdat, 1989. – 528 s.