EXAMINING THE EFFICIENCY OF THE SEMI SUBSTITUTION OF THE MAIZE WITH BY-PRODUCTS OBTAINED IN MANUFACTURING VEGETABLES AND FRUITS IN MIXTURES FOR GROWING AND FATTENING PIGS IV. RELATIVE PROPORTION OF BONES, MUSCLE AND FAT TISSUE IN THE CARCASS

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ABSTRACT

The aim of this experiment was examine the possibilities of the maize's substitution as an energetic nutrient with by-products obtained by manufacturing tomatoes, peppers and grapes in the nutrition of swine on the relative proportion of bones, muscle and fat tissue in the carcass.

Average Relative Proportion of Bone, Muscle and Fat Tissue in Carcass (ARPBMFTC) of fattening pigs were (7.45%; 42.00%; 21.62%-K group), (7.92%; 44.78%; 18.51%-O-I group) and (7.55%; 46.20%; 16.81%-O-II group), respectively. Significant difference was observed in K, O-I and O-II groups ($p<0.05$) on Muscle and Fat Tissue content.

In the other side, Average Share of Bone, Muscle and Fat Tissue in Part (ASBMFTP) in total weight, about on the Leg (L), on the Shoulder (S), on the Ridge Part (RP), on the Neck (N) and on the Ribs (R) were (10.40 kg; 5.47 kg; 7.67 kg; 2.88 kg; 2.39 kg-K), (10.69 kg; 5.76 kg; 7.57 kg; 3.18 kg; 2.34 kg-O-I) and (10.95 kg; 5.82 kg; 7.51 kg; 3.01 kg; 2.43 kg-O-II), respectively. No significant difference was observed in all three groups ($p>0.05$).

Key words: *Relative proportion of bones, muscle and fat tissue in carcass, leg, shoulder, loin, ridge part, neck, ribs*

Introduction

Intensive livestock production places very high demands on the animal organism, as well as on industry of animal food. Objective of intensive pig production is realization of the highest possible gain with the lowest possible consumption of food per unit of gain, in the shortest possible time, and resulting in production of feedstuffs of animal origin free of harmful substances, taking into consideration health condition of animals.

Performance of fattening pigs is expressed not only by parameters used to define gain and food consumption (per animal and per unit of gain), but also measures used to define meat yield, the share of certain carcass parts and the tissues in major carcass parts.

Dressing percentage, among other things, depends on the body condition of animal prior to slaughtering, type of diet and transportation conditions [Teodorović and Radović, 2004]. Young animals have lower dressing percentage (69.4-72.5%), and exceptionally fatty animals have higher dressing percentage (76.3-80.3%).

Conformation includes general built, shape and proportions of carcass sides. In assessment of conformation, special attention is directed to appearance and development of those carcass side parts which contain the musculature of the highest quality (leg, loin, shoulder) and in relation to other less valuable parts (head, neck, belly, feet). Results of the dissection of carcass sides have the greatest informational value from the aspect of selection work in pig breeding. Total dissection is the most accurate way for determination of the amount of muscle and fat tissue in carcass. Procedure is not practical, but the values are very objective and therefore it is most commonly used in research purposes.

Republic of Macedonia have a lot of amount from those by-products (tomatoes 5-10%; grapes 20-25% and peppers 25-30%). Therefore, study of the effect of substitution of maize with by-products obtained in processing of tomatoes, peppers and grape on the performance, health

condition of growing and fattening pigs and relative proportion of bone, muscle and fat tissue in the carcass is scientifically justifiable and of great interest for practice.

Materials and methodS

The objective was to examine the possibility of maize substitution with by-products obtained by manufacturing tomatoes, peppers and grapes in the nutrition of pigs.

The chemical composition of by-products obtained during processing of tomatoes, peppers and grapes used in the experiment is shown in Table 1.

Table 1. Chemical composition of the tested by-products and corn, [%]

Chemical composition	By-products			Corn
	Grapes	Peppers	Tomatoes	
Moisture	8.40	8.61	8.18	13.00
Ash	4.36	6.15	3.38	1.20
Protein	12.66	18.77	21.15	8.00
Fat	10.60	8.18	13.20	4.00
Fibre	39.16	37.78	39.31	2.10
NEM	24.82	20.51	14.78	71.70
Calcium	0.64	0.56	0.41	0.02
Phosphorus	0.41	0.82	0.36	0.30
ME, MJ/kg	8.99	8.50	8.61	13.97
Lysine	0.33	0.29	0.31	0.20
Methionine+cystine	0.13	0.15	0.11	0.26
Threonine	0.18	0.10	0.02	0.10
Tryptophane	0.35	0.25	0.22	0.40

The table notes that, tested products contain significantly higher amounts of protein and fat compared to corn, with slightly less favorable protein has the amino acid composition. On the other hand, due to the extremely high content of fiber and very low carbohydrate content, are much poorer source of energy than corn.

A trial was organized according to the group-control system in production conditions on pig farm ZZ "Edinstvo" village Čelopek from Tetovo, Republic of Macedonia. Trial was realized on pigs in growing and fattening period, at the age of approx. 60 days and average body mass of 27,00±0,64-27,69±0,71 kg. In trial, crosses of Swedish and Dutch landrace of uniform genetic potential were used. Every group in trial consisted of equal number of male and female animals.

In the trial, technology of housing, rearing, care and the nutrition was used for experimental animals which is commonly used in the production on the farm with moderate modifications required by the experiment design. Animals received water from automatic waterers, and feeders were filled manually, so that there was always sufficient food in them. Animals received food and water ad libitum.

In forming of the trial, animals were examined clinically, and all animals selected for the trial were healthy, vital and in good condition. In forming of groups it was taken into the account that animals were of uniform body mass, and each animal was identified with ear tag in order to enable individual monitoring during the entire trial. During the trial, health condition of experimental animals was monitored daily.

Trial was carried out on the pigs in growing and fattening period, total of 48 animals divided into 3 groups, and each group consisted of 8 animals of each sex (16 animals per group). Trial lasted 100 days and it was divided into two phases of 50 days. During trial, body mass of trial animals was recorded as well as quantity of feed intake, and samples of complete mixtures were collected for analysis. Pigs in growing and fattening were fed adequate complete mixtures of standard composition in regard to ingredients and chemical composition (table 2). Two mixtures

used in the trial fully satisfied the requirements of pigs [AEC, 1993; NRC, 1998; Regulation, 2000], complete mixture for pigs in growing and fattening, from 1st to 50th day, and complete mixture for fattening pigs, from 50th to 100th day of trial.

Table 2. Composition of mixture in the nutrition of growing and fattening pigs, [%]

Feedstuffs	from 25-60 kg			from 60-100 kg		
	K	O-I	O-II	K	O-I	O-II
Maize	61.20	55.20	52.20	63.90	57.90	54.90
By product of tomatoes	-	2.00	3.00	-	2.00	3.00
By product of peppers	-	2.00	3.00	-	2.00	3.00
By product of grapes	-	2.00	3.00	-	2.00	3.00
Wheat bran	12.00	12.00	12.00	15.00	15.00	15.00
Soya bean meal	16.00	16.00	16.00	10.00	10.00	10.00
Sunflower meal	5.00	5.00	5.00	7.00	7.00	7.00
Fish meal	1.00	1.00	1.00	-	-	-
Soya oil	2.00	2.00	2.00	1.00	1.00	1.00
Limestone	1.20	1.20	1.20	1.40	1.40	1.40
Di Calcium Phosphate	0.70	0.70	0.70	0.70	0.70	0.70
Salt	0.40	0.40	0.40	0.50	0.50	0.50
Premix	0.50	0.50	0.50	0.50	0.50	0.50

Main objective of the study was to establish the effect of maize substitution with by-products obtained in processing of tomatoes, peppers and grape, in the nutrition of growing and fattening pigs on performance and health condition, and to establish justification for the use of fore mentioned by-products in pig nutrition. Therefore, mixtures were corrected to certain extent in order to realize set objective. Animals in the control group were fed mixtures without investigated by-products, whereas animals in the trial group received food where maize had been substituted with mentioned by-products, in the amount of 6%, i.e. 9% of by-products.

At the end of the trial, pigs were transported to slaughterhouse, and meat yield and meatiness of carcass sides determined on slaughter line. Trial animals were measured individually prior to slaughtering, and subsequently mass of warm carcass sides was measured. Meatiness of warm carcass sides was calculated using obtained data and standard tables.

After cooling halves of 4^{o}C over 24 hours performed the cutting of the basic parts and determination of relative and absolute share of individual parts by weight of the halves. The individual parts of the body is made separation and measurement of bones, muscle and fat tissue.

Results and discussion

The relative proportion of bones, muscle and fat tissue in the carcass is shown in Table 3. It is evident that the relative proportion of bones in the carcass is very little different between experimental groups, the differences were not statistically significant ($p > 0.05$).

On the other hand, are more pronounced numerical differences are observed in the relative proportion of muscle and fat tissue in the carcass of individual groups of pigs. It is interesting to underline that an increasing proportion of muscle tissue in proportion to the reduction of the share of fat in the carcass. The difference between both experimental groups, with one hand and the control group, on the other hand, were statistically significant ($p < 0.05$). The upward trend of the relative proportion of muscle tissue in the carcass ($y = 2.1 x + 40.127$) was determined by linear character and a very high correlation coefficient ($rxy = 0.966$). Similar to the above, the negative trend of the contribution of fat in the carcass ($y = -2.405 x + 23.79$) is a linear character and is determined with very high coefficient correlation ($rxy = 0.972$).

Table 3. Relative proportion of bones, muscle and fat tissues in carcass [%]

Group	n	Measures of variation X	±	Sx	Sd	Cv	Iv
				Bones			
K		7.45		0,06	0,14	3,29	7,10-7,85
O-I		7.92		0,04	0,10	2,80	7,12-8,36
O-II		7.55		0,05	0,12	2,95	6,96-8,21
				Muscle tissue			
K		42.00 [a]		0,20	0,95	5,03	39,95-44,21
O-I		44.78 [b]		0,72	3,54	4,62	48,52-52,21
O-II		46.20 [b]		0,95	2,33	9,54	42,33-50,01
				Fat tissue			
K		21.62 [a]		0,13	0,40	2,78	20,36-22,41
O-I		18.51 [b]		0,10	0,35	2,39	17,95-19,22
O-II		16.81 [b]		0,11	0,42	2,51	15,72-17,83

a, b $p<0.05$

Looking at the proportion of bones, muscle and fat tissue in certain parts of carcasses of slaughtered pigs (Tab. 3) observed a relatively constant proportion of bones with a slight diminution in the proportion of fat followed by a slight increase in muscle tissue with no statistically significant difference ($p> 0.05$)

Table 4. * Share of bones, muscle and fat tissue in part, in [kg]

Group	Total weight	Tissue, the proportion of		
		Muscle tissue	Fat tissue	Bones
			Leg	
K	10.40±0.79	6.56±0.31	2.70±0.15	1.14±0.04
O-I	10.69±0.84	7.32±0.33	2.17±0.11	1.20±0.05
O-II	10.95±0.82	7.48±0.35	2.22±0.13	1.25±0.07
			Shoulder	
K	5.47±0.55	3.59±0.18	1.17±0.07	0.71±0.04
O-I	5.76±0.50	4.00±0.22	0.94±0.05	0.82±0.05
O-II	5.82±0.52	3.84±0.20	1.02±0.06	0.96±0.06
			Ridge part	
K	7.67±0.25	4.01±0.23	2.48±0.15	1.18±0.02
O-I	7.57±0.27	4.49±0.25	1.91±0.11	1.17±0.03
O-II	7.51±0.21	4.16±0.21	2.19±0.13	1.16±0.02
			Neck	
K	2.88±0.36	1.90±0.11	0.59±0.02	0.39±0.02
O-I	3.18±0.43	2.17±0.15	0.56±0.01	0.45±0.01
O-II	3.01±0.48	2.04±0.13	0.55±0.02	0.42±0.01
			Ribs	
K	2.39±0.25	1.18±0.04	0.90±0.02	0.31±0.01
O-I	2.34±0.35	1.32±0.07	0.68±0.01	0.34±0.02
O-II	2.43±0.30	1.36±0.08	0.74±0.02	0.33±0.01

* values expressed as X ± SD

Conformation includes general built, shape and proportions of carcass sides. In assessment of conformation, special attention is directed to appearance and development of those carcass side parts which contain the musculature of the highest quality (leg, loin, shoulder) and in relation to other less valuable parts (head, neck, belly, feet). Results of the dissection of carcass sides have the greatest informational value from the aspect of selection work in pig breeding. Total dissection is the most accurate way for determination of the amount of muscle and fat tissue in carcass. Procedure is not practical, but values are very objective and therefore it is most commonly used in research purposes.

In addition to decrease of back fat thickness and increase of meatiness of warm carcass sides, as a qualitatively new finding it is necessary to point out numerical differences in relative share of muscle and fat tissue in carcass sides from pigs belonging to certain groups, and it should be underlined that the increase of share of muscle tissue is proportional to decrease of the share of fat tissue in carcass sides. Established differences between both trial groups, on one side, and control group, on the other, were statistically significant ($p<0.05$). Upward trend for share of muscle tissue in carcass sides ($y = 2,1x + 40,127$) is of linear character and determined with very high correlation coefficient ($r_{xy}=0,966$). Similar to this, negative trend of share of fat tissue in carcass sides ($y = -2,405x + 23,79$) ($r_{xy}=0,972$).

Also, dissection results indicate that the share and development of those carcass side parts containing the most of high valuable musculature (leg, shoulder) are slightly increasing. Also slight decrease of share of fat tissue is registered, followed by moderate increase of muscle tissue without statistically significant differences ($p>0.05$).

It can be concluded that partial substitution of maize with by-products obtained in processing of grapes, tomatoes and peppers, especially in quantity of 6% had no negative effect on yield of meat in growing and fattening pigs. Also, positive effects on certain meat parameters, especially on meatiness of carcass and amount of muscle and fat tissue in carcass have been registered.

Conclusions

Based on results obtained in executed study of the possible substitution of maize as energy feed, with by-products obtained in processing of tomatoes, peppers and grape in pig nutrition on performance and health condition of animals, the following can be concluded:

- partial substitution of maize with by-products obtained in processing of grape, tomatoes and peppers, especially in quantity of 6% had no negative effect on performance of pigs in growing and fattening period;
- utilization of by-products obtained in processing of tomatoes, peppers and grape in partial substitution of maize in mixtures for pig nutrition, positive effects on certain meat yield parameters were established, especially on meatiness of carcass and amount of muscle and fat tissue in carcass.

In general, applied treatments had no negative effect on performance and health condition of pigs, which provides objective possibility for partial substitution of maize with by-products obtained in processing of tomatoes, peppers and grapes.

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