

# EXAMINING THE EFFICIENCY OF THE SEMI SUBSTITUTION OF THE MAIZE WITH A BY-PRODUCTS OBTAINED BY MANUFACTURING VEGETABLES AND FRUITS IN MIXTURES FOR GROWING AND FATTENING PIGS\*\*

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**Abstract:** To 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 production results and health condition where are carried out experiment in the nutrition of growing and fattening pigs.

The researches are conducted in the producing conditions at pigs farm ZZ "Edinstvo" in the village of Chelopek near by the town of Tetovo, Republic of Macedonia, where are organized experiment in a group controlled system. The experiment is carried out on growing and fattening pigs in a period of about 60 days with an average body weight of  $27.00 \pm 0.64$  –  $27.69 \pm 0.71$  kg. For the experiment used mongrels of Swedish and Dutch races with equalized genetical potential. Each group in experiment consist of equal number of males and females.

The experiment of the growing and fattening pigs is carried out on 48 pigs divided into 3 groups with each group having 8 pigs of different sex. The experiment lasted for 100 days in 2 phases with 50 days each phase. In the experiment are used 2 mixtures for growing and fattening pigs from 1 – 50 days and the whole mixture for fattening pigs in a period of 50 – 100 days of the experiment. The experimental pigs from the control group from

experiment are fed with mixture without a share from the examined by-products, whereas the sample groups were fed with food with substitution of the maize with different qualities of the above mentioned by-products. In the pig's feeding mixture – 6% i.e. 9% from the examined by-products.

Maize's semisubstitution with a by-products obtained by manufacturing tomatoes, peppers and grapes especially in the amount of 6% does not have any negative effects in the production results on a growing and fattening pigs. In overall, the applied treatments do not have negative influence in the production results and health condition of swine which enables real possibilities for maize's semisubstitution with a by-products obtained by manufacturing tomatoes, peppers and grapes.

**Key words:** nutrition, growing and fattening pigs, by-products obtained by manufacturing tomatoes, peppers and grapes, production results

## Introduction and Literature review

Intensive stockbreeding makes a lot of demands regarding the organism of the domestic animals and the animal feed industry as well. The aim of intensive pig breeding is to obtain a greater growth rate with as lesser food per growth unit as possible in the shortest possible period for production of animal feed without harmful substances, looking after the animals' health condition in the same time. Because of the specific way of nutrition, treatment, lodges and the breed composition in our productive condition, in the literature review regarding production of growing and fattening swine we listed only those of intensive researches (*Maričić*, 1981; *Marečić*, 1984; *Arsenijević*, 1982; *Manojlović*, 1985; *Živković*, 1986; *Djurica*, 1987; *Damjanović*, 1987; *Damjanović*, 1991). There are two very significant problems in the development of stock-breeding regarding the provision of sufficient products of animal origin with high biological value, that should be solved. From one side, the animal feed industry should produce the necessary amounts of animal feed, and from the other side, there is a rising problem in the lack of specific nutrients. Among other, one of the preconditions for sufficient industrial production of animal feed is having sufficient specific nutrients, especially energetic nutrients which are 40% of the instant food. 80% of the overall energetic nutrients can be provided by the domestic production, while the remaining 20% are imported. On the other side, in years with unfavorable climate for the crops, the amount of energetic nutrients, especially maize, is far from satisfying the demands of

the animal feed industry, and there is also significant deficit in the import conditions. Therefore, as a result of losing the balance in the foreign trade, the animal feed production, stockbreeding included, is brought into dependence on imported raw materials. Understandably, efforts are made to reach solutions for rational usage of energetic nutrients domestically produced especially their replacement and greater usage of by-product of food industry. The situation is even more actualized by problems regarding the necessary unstinting removal of by-products of food industry that are produced during the processing of raw materials from animal origin into food products for humans.

Researches made so far have highlighted numerous by-products of great significance and have included them in the nutrition. First of all, we should mention by-products of mill industry (stock flower and bran), oil industry (beans), sugar industry (turnip noodles). Apart from this, in the conditions in R. Macedonia, there are numerous other secondary raw materials which emerge in the primary production from the agro-complexes. From the unconventional by-product of agro-complexes, attention should be paid to the by-product of tomatoes, peppers and grapes. During the processing of tomatoes, peppers and grapes there is 5-10, 25-30 and 20-25 % by-product respectively. Most of the publication of results from nutrition value researches of this by-products (*Sinovec and Šeković, 1995; Radovanović and Rajić, 1990; Stojanović et al., 1989; Todorov, 1995; Shokarovski and Cilev, 1999*) point out that there is significant content of energy, and relatively satisfying amount of proteins as well. The nutrient value and the effectiveness is proved by biological experiments on ruminants (*Smilevski et al., 1973, 1975; Damjanovska et al., 1988; Shokarovski et al., 1981; Bogdanov, 1980*), but with the increasing production of pork meat and chicken meat this effects should be inspected in the non-ruminant nutrition as well, all the more because this animals are concurrent to humans in the food choice.

Therefore it is practically and scientifically justified to investigate the impact of maize's substitution with by-products of tomatoes, peppers and grapes, on the production and health condition of growing and fattening pigs.

## **Material and methodology**

With the objective to examine the possibility of maize's substitution with by-products obtained by manufacturing tomatoes, peppers and grapes in the nutrition of swine on experiment by group control system was carried out on

the productive results and health conditions at the producing condition on the pigs farm ZZ "Edinstvo", village Chelopek, Tetovo region, R. Macedonia. The experiment was carried out on growing and fattening pigs about 60 days old and with average weight of  $27.00+0.64-27.69\pm 0.71$  kg. For the experiment were used mongrels from Suisse and Dutch race with equalized genetic potential. Each group consisted of equal number of males and females.

During the experiment, technology was used for treatment, lodgment, care and way of nutrition and watering of the experimental heads that are habitual in the regular production, with minimal modification required during the execution of the experiment. Each individual was placed in a stall during the experiment. Before the experimental animals were let inside, the rooms where the experiment was carried out were previously prepared. After the mechanic cleansing and sanitarian wash out, the room and the equipment were disinfected with biodegrading disinfectant with broad range of functions. The hygienic and microclimatic conditions were completely in accordance with the technological norms for this swine category. Watering was done through automatic watering-places, and the food was filled manually in such a manner that there is enough food for each pig. The nutrition and watering was done by will (ad libitum).

An individual medical examination was carried out for the experiment groups, and all selected individuals were healthy, vital and in good condition. During the group formation it was taken in consideration that all individual should be at approximately same and each individual was marked with a number on the ear, so it was possible to monitor each individual separately during the experiment. The health condition was monitored each day during the experiment.

The experiment of the growing and fattening pigs is carried out on 48 pigs divided into 3 groups with each group consisting of 8 pigs of different sex. The experiment lasted for 100 days in 2 phases each lasting for 50 days. The weight of the pigs and the amount of consumed feed were measured on a regular basis during the experiment. The growing and fattening pigs were fed with suitable whole mixture with standard composition of standard raw and chemical components (table 1). Two mixtures were used during the experiment that completely satisfied the needs of the pigs (*AEC, 1993; NRC, 1998; Pravilnik 2000*), those are whole mixture for growing and fattening pigs for 1-50 days, and whole mixture for fattening pigs for 50-100 days experimental period.

The main aim of the research was to determine how the maize

substitution with by-products, obtained by manufacturing tomatoes, peppers and grapes in the nutrition of growing and fattening pigs, influence the production results and the pig's health condition and to determine whether it is practical to use mixtures with by-products in the nutrition of pigs. To this end minimal corrections were made in the mixtures. The experimental pigs from the experimental control group were fed with mixtures not containing any of the above mentioned by-products, whereas the experimental groups were fed only with mixtures where maize was substituted with different quantities of the specified by-products. There were 6, which are 9%, from the examined by-products in the mixtures for swine nutrition.

**Table 1. Composition of mixture for nutrition of growing and fattening pigs, [%]**

Feeds	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
DCaP	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

The feed samples for examination were taken in the same time interval each 30 days. Taking samples and the preparation of animal feed were performed in accordance with the Regulation of methods for sample taking and physical, chemical and microbiological analysis of animal feed (15/1987). The control measurements of the experimental pigs were made with technical scale with accuracy of  $10^{-2}$  kg. Relying on the results from the measurement the average weight was calculated, the overall growth was calculated by deducting the body weights, whereas the daily growth was calculated both for particular phases and for the experiment as a whole.

The amounts of whole mixtures given to particular groups were accurately measured during the experiment. At the end of the experiment the consumed feed was calculated (in total and for particular phases) by collecting the amounts daily consumed. For the obtained information about

the consumption and the growth, the food consumption was calculated for each phase separately and for experiment as a whole as well.

Apart from the preventive program for protection, the experimental pigs were under constant veterinary-medical control, and all changes in their health condition were observed and noted. The daily observations were carried out by individual or group monitoring.

## Obtained results and discussion

The chemical composition of mixtures used during the experiment for the nutrition of the pigs is presented in the table 2. It can be seen from the table that the maize substitution with the examined by-products obtained by manufacturing tomatoes, peppers and grapes inconsiderably increases the content of proteins, fats and cellulose, energy as well, while the content of amino acids remains relatively unchanged.

**Table 2. Chemical composition of mixture for nutrition of growing and fattening pigs, [%]**

Chemical composition	from 25-60 kg			from 60-100 kg		
	K	O-I	O-II	K	O-I	O-II
Moisture	11.45	11.17	11.04	11.63	11.35	11.22
Ash	5.06	5.27	5.37	5.06	5.26	5.36
Proteins	16.14	16.72	17.00	14.24	14.81	15.09
Fat	5.30	5.70	5.90	4.47	4.87	5.07
Fibre	4.56	6.76	7.86	5.01	7.21	8.31
NEM	57.49	54.38	52.83	59.59	56.50	54.95
Calcium	0.80	0.83	0.85	0.79	0.82	0.83
Phosphorus	0.63	0.64	0.65	0.62	0.64	0.64
ME, MJ/kg	13.60	13.69	13.74	13.04	13.14	13.18
Lysine	0.77	0.78	0.78	0.60	0.60	0.61
Methionine+cystine	0.52	0.51	0.50	0.47	0.46	0.46
Threonine	0.23	0.23	0.23	0.19	0.19	0.19
Tryptophane	0.43	0.42	0.41	0.43	0.42	0.42

The proportion and the quantity share of the feeds in the mixture for nutrition of the experimental animals are determined in a way commonly applied in productive condition. The results from the analysis of the chemical content of mixtures used for the nutrition of growing and fattening pigs showed that the animal feed used during the experiment was in accordance with the technological norms and regulations (*Pravilnik*, 2000), that is to say that the nutrient content of the mixtures satisfied the needs of

specific categories of swine in different growing and fattening phases (NRC, 1998; AEC, 1993). The chemical analysis confirmed the balance of the content of particular amino acids (lysine, methionine, threonine and tryptophane) in the mixture of the nutrition of the control groups of animals. The chemical composition, including the composition of the amino acids, of the mixtures for nutrition of the experimental groups where the maize substituted with by-products obtained by manufacturing tomatoes, peppers and grapes, hasn't changed significantly in comparison to the control mixtures.

Having in mind the above mentioned it can be concluded that the chemical composition of the whole mixtures, used for the swine nutrition, designed for particular groups is such that, on the other side, meets the needs, and on the other side, is in accordance with the requirements for making an experiment.

At the beginning of the experiment the pigs from all experimental groups weighted equally, and there weren't any statistically significant differences (table 3). In the middle of the experiment the pigs from all experimental groups equally increased in weight, while the pigs from 0-I group weighted insignificantly more than those from the control group. At the end of the experiment all experimental groups weighted a little more in comparison to the control groups. However, in spite of the difference in the numbers there was no statistically significant ( $p > 0.05$ ) difference between the experimental groups. Moreover, on the basic of these results it can be concluded that the applied treatments had no influence to the body weight.

**Table 3. Body weight of growing and fattening pigs in the experiment, [kg]**

Groups	n	Measures of variation					
		X	±	Sx	Sd	Cv	Iv
<u>1 day</u>							
K		<b>27.00</b>		0.64	2.56	9.49	23.50-33.50
O-I		<b>27.69</b>		0.71	2.85	10.30	23.50-34.00
O-II		<b>27.50</b>		0.68	2.65	9.80	23.50-34.00
<u>50 day</u>							
K		<b>61.50</b>		1.79	7.16	11.65	48.00-71.00
O-I		<b>62.06</b>		2.17	8.70	14.01	46.00-79.00
O-II		<b>57.10</b>		2.20	8.60	15.02	44.00-74.00
<u>100 day</u>							
K		<b>96.20</b>		3.28	13.10	13.62	90.20-115.20
O-I		<b>98.10</b>		4.63	15.53	16.81	89.20-125.10
O-II		<b>99.50</b>		3.40	13.89	14.15	92.00-117.00

The average daily gain of the growing and fattening pigs from particular experimental groups varied from group to group and in different phases of the experiment (table 4). In the first phase of the experiment the control group attained the biggest growth, while the 0-II group of pigs attained the smallest and the 0-I group attained almost the same growth. In the second phase of the experiment the pigs from both experimental groups attained a little bigger growth, which regarding the experiment as a whole resulted with almost identical growth regardless of the treatment they were given. Despite the difference in the numbers, according to the statistic analysis there wasn't any significant difference in the growth of the experimental pigs during the experiment ( $p > 0.05$ ).

**Table 4. Gain of growing and fattening pigs in the experiment, [kg/day]**

		Measures of variation					
Groups	n	X	±	Sx	Sd	Cv	Iv
<u>1 day</u>							
K		<b>0.630</b>		0.03	0.12	17.82	0.441-0.882
O-I		<b>0.627</b>		0.03	0.13	19.56	0.422-0.905
O-II		<b>0.592</b>		0.04	0.14	19.82	0.411-0.862
<u>50 day</u>							
K		<b>0.794</b>		0.03	0.12	17.74	0.444-0.885
O-I		<b>0.820</b>		0.03	0.12	16.70	0.462-0.922
O-II		<b>0.848</b>		0.03	0.12	15.92	0.489-0.919
<u>100 day</u>							
K		<b>0.712</b>		0.03	0.12	17.78	0.542-0.882
O-I		<b>0.724</b>		0.03	0.13	18.00	0.541-0.911
O-II		<b>0.720</b>		0.02	0.11	15.74	0.595-0.920

However, though the body weight is good indicator, it is considered that the daily gain is better indicator of the quality of the food. When analyzing the obtained results it can be seen that growing and fattening pigs from the control group had high average daily gain of 0,712 kg throughout the experiment. It is considered that the nutrition with standard mixtures provide satisfying daily gain of 600-700 g (*Maričić, 1985; Manojlović, 1985; Damjanović, 1991*), but in productive conditions (*Živković, 1986*) even bigger growth (789±39) is noted.

When comparing the experimental group with the control group it can be noticed that the pigs from both group attained some bigger daily gain (figure 1) but, despite the difference in the numbers, according to the statistic analysis the differences between the experimental groups were not



statistically significant ( $p>0.05$ ).

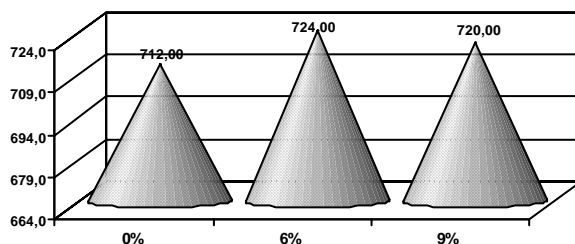


Figure 1. Daily gain [g]

The average daily feed consumption is presented in table 3-5.

Table 5. Consumption of feed in the experiment, [kg/day]

Phase of experiment	Groups		
	K	O-I	O-II
	<u>Growing and fattening pigs</u>		
1-50 day	1.64	1.58	1.57
Index	100.00	96.34	95.73
50-100 day	2.70	2.58	2.50
Index	100.00	95.56	92.59
1-100 day	2.17	2.08	2.03
Index-	100.00	95.85	93.55

From the data presented in the table 5 it can be noted that, during both phases of the experiment, the growing and fattening pigs from the experimental groups consumed smaller amounts of feed in comparison to the pig from the control groups. Taking the experiment as a whole, the feed consumption was impersonally proportional to the share of examined by-products in the mixtures, according to which the feed consumption of the experimental groups is lower for 4,15, that is 6,45%.

The appetite is one of the foremost indicators of the animal health condition and of the quality of the feed. Growing and fattening pigs of the groups fed with mixtures of standard raw materials consumed feed (2,17 kg) in amounts common in productive conditions, which part from 2,11-2,64 kg (Maričić, 1985; Manojlović, 1985; Živković, 1986; Djurica, 1987). The pigs from the experimental groups consumed less feed proportionally to the increased share of examined by-products (figure 2) during particular phases

and during the whole experimental period as well.

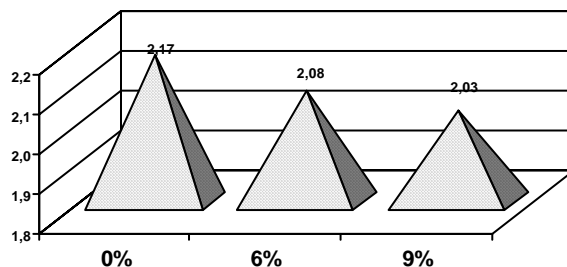


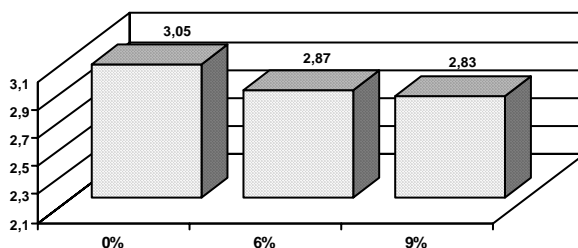
Figure 2. Consumption of feed, [kg]

The feed conversion, as an interaction between gain and feed consumption is presented in table 3-7.

Table 6. Conversion of feed in the experiment, [kg]

Phase of experiment	Groups		
	K	O-I	O-II
<u>Growing and fattening pigs-</u>			
1-50 day	2.60	2.52	2.65
50-100 day	3.40	3.15	2.95
1-100 day	3.05	2.87	2.83
Index	100.00	96.92	101.92
Index	100.00	92.64	86.78
Index	100.00	94.10	92.79

The feed conversion, as an interaction between gain and consumption, is the resultant which represents one of the best indicators of the quality of the feed. Growing and fattening pigs from groups fed with mixtures with standard contents attained food conversion common during productive conditions, that parts from 3.0-3.5 kg (Maričić, 1985; Manojlović, 1985; Djurica, 1987; Damjanović, 1991) but even significantly (about and below 3 kg) better feed conversion is noted (Živković, 1986). The information regarding the feed conversion of growing and fattening pigs showed that the applied treatments had positive effects on the examination parameter in both phases, which resulted in better feed consumption in the experimental groups for 5,90, that is 7,21% (figure 3).



**Figure 3. Conversion of feed, [kg]**

Summarizing the results from the whole experiment it can be concluded that maize semi substitution with a by-product obtained by manufacturing tomatoes, peppers and grapes especially in the amount of 6% does not have any negative effects on the results from the production of growing and fattening pigs.

## Conclusion

Considering the results from the research of the possibility of maize substitution, as energetic nutrient, with by-products obtained by manufacturing tomatoes, peppers and grapes in the nutrition of the pigs we can make the following conclusions regarding the production results and the health condition:

- Maize semi substitution with a by-products obtained by manufacturing tomatoes, peppers and grapes especially in the amount of 6% does not have any negative effects on the results from the production of growing and fattening pigs.
- Overall, the applied treatments do not have negative influence in the production results and health condition of pigs which allows maize to be semi substituted with by-products obtained by manufacturing tomatoes, peppers and grapes.

# ISPITIVANJE EFIKASNOSTI DELIMIČNE SUPSTITUCIJE KUKURUZA SPOREDNIM PROIZVODIMA PRERADE POVRĆA I VOĆA U SMEŠAMA ZA SVINJE U PORASTU I TOVU

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## Rezime

U cilju ispitivanja mogućnosti supstitucije kukuruza, kao energetskog hraniva, sporednim proizvodima dobijenim pri preradi paradajza, paprika i grožđa u ishrani svinja na proizvodne rezultate i zdravstveno stanje izveden je ogled ishrane svinja u porastu i tovu.

Istraživanja su izvedena u proizvodnim uslovima na svinjarskoj farmi ZZ "Edinstvo" s. Čelopek iz Tetovskog, R. Makedonija gde je organizovan ogled po grupno-kontrolnom sistemu. Ogled je izveden na svinjama u porastu i tovu u dobi od oko 60 dana i prosečne telesne mase  $27,00 \pm 0,64$ - $27,69 \pm 0,71$  kg. Za ogled su korišćeni melezi švedskog i holandskog landrasa ujednačenog genetskog potencijala. Svaka grupa u ogledu se sastojala od podjednakog broja muških i ženskih životinja. Ogled na svinjama u porastu i tovu je izveden na ukupno 48 grla podeljenih u 3 grupe, a svaka grupa se sastojala od po 8 grla različitog pola. Ogled je trajao ukupno 100 dana i podeljen je na dve faze po 50 dana. U ogledu korišćene su dve smeše i to potpuna smeša za svinje u porastu i tovu od 1-50. dana i potpuna smeša za svinje u tovu od 50-100. dana ogleda. Eksperimentalna grla kontrolne grupe hranjena su smešama bez učešća ispitivanih sporednih proizvoda, dok su ogledne grupe dobijale hranu u kojoj je izvršena supstitucija kukuruza različitim količinama navedenih sporednih proizvoda. U smešama za ishranu svinja 6, odnosno 9% ispitivanih sporednih proizvoda. Delimična supstitucija kukuruza sporednim proizvodima dobijenim pri preradi paradajza, paprike i grožđa, posebno u količini od 6%, nema negativne efekte na proizvodne rezultate svinja u porastu i tovu. U celini, primenjeni tretmani ne utiču negativno na proizvodne rezultate i zdravstveno stanje svinja što pruža realnu mogućnost delimične supstitucije kukuruza sporednim

proizvodima dobijenim pri preradi paradajza, paprike i grožđa.

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