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THE EFFECT OF PARTIAL MAIZE SUBSTITUTION WITH BY-PRODUCTS IN PIGLET NUTRITION I. PRODUCTIVE RESULTS

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Abstract

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A large amount of agriculture's by-products are produced by food industries of R.Macedonia. 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 weaned piglets on the production results. The researches were conducted in the producing conditions at pigs farm ZZ "Edinstvo" in the village of Chelopek near by the town of Tetovo, R. Macedonia where were organized experiment in a group controlled system. The experiment is carried out on piglets after weaning in a period of 28-30 days with an average body weight of 8.66±0.21 kg (K); 8.79±0.20 kg (O-I) and 8.84±0.19 kg (O-II). 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 weaned piglets is carried out on 72 piglets divided into 3 groups with each group having 12 piglets of different sex. The experiment lasted for 42 days in 2 phases with 21 days each phase. In the experiment were used 2 mixtures for weaned piglets (8–15 kg) from 1–21 days and the whole mixture for piglets in breeding (15–25 kg) in a period of 21–42 days of the experiment (NRC, 2000).

The piglets from the control group (K) from experiment were fed with mixture without a share from the examined by-products, whereas the experimental groups (O-I and O-II) were fed with food with substitution of the maize with different qualities of the above mentioned by-products. In the piglets feeding mixture-3% (O-I) i.e.6% (O-II) from the examined by-products.

Average Body Weight (ABW) in the control group (K) and experimental groups (O-I and O-II) in the end of the growing period (42 day) were 26.98 kg-K, 27.37 kg-O-I and 26.02 kg-O-II, respectively. Average Daily Gain (ADG) and Average Feed Conversion (AFC) in the control group (K) and experimental groups (O-I and O-II) for all period (1–42 days) were (436 g *vs* 1.51 kg-K), (445 g *vs* 1.50 kg-O-I) and (409 g *vs* 1.47 kg-O-II). No significant difference was observed in all three groups ($p > 0.05$).

Maize's partial substitution with a by-products obtained by manufacturing tomatoes, peppers and grapes especially in the amount of 3% does not have any negative effects in the production results on a weaned piglets.

Key words: nutrition, weaned piglets, by-products obtained by manufacturing tomatoes, peppers and grapes, production results

Introduction

The intensive animal production is very demanding towards the organism of the domestic animal, as well as the animal food industry. The goal of the intensive pig production is high growth with minimal food consumption in shortest time giving animal products without harmful substances at the same time taking care of the animal's health. Because of

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the differences in nutrition, husbandary, accomodation and pig breeds in our conditions of production we only review the literature that is a result of extensive research done on weaned piglets production (Kovčin and Pejić, 1988; Waaijenberg, 1987; Puača, 1970; Collier and Hardy, 1986; Rotar and Salobir, 1987; Inborr, 1989, 1990; Inborr, 1989a; Officer, 1992; Cowan, 1995; Easter, 1995; Graham, 1996; Partridge, 1997; Grujić, 1998; Dabetić, 1999*)*.

Breeding animals has developed as means of providing enough quantities of food from animal origin that is biologically valuable. Achieving it, there are two main problems that need to be solved: producing large quantities of industrial feeds for animals and dealing with the shortage of certain feeds. One of the prerequisites for producing industrial feeds for animals is providing each feed, especially those high in energy which constitute above 40% of the total mixture. In Macedonia 80% of the energetic feeds can be obtained from the production by the domestic industry, the other 20% are imported. Unfavorable climatic conditions further complicate the situation with energetic feed production, especially maize. The difficulties apply to the export of feeds too. So beside the hampered foreign trade, the production of feeds for animals and the animal breeding in general depends on imported feeds. That justifies the striving for solutions for rational using of the energetic feeds of domestic origin, and substituting them, e.g. with by-products from the food industry. The non-hazardous disposal of by-products obtained from the food industry during the manufacturing of foods from plant origin into human consumption foods further actualizes the situation.

The research to date has noted and established in practice a great number of by-products. Especially, there should be mentioned the by-products obtained from the wheat industry (wheat flour, wheat bran), cooking oil industry (pellets), sugar industry (dry slices of sugar beet). In Macedonia there are other by-products that can be obtained from the agrocomplexes. The unconventional by-products that receive most attention are those obtained from tomatos, peppers and grapes. The waste from the manufacturing of the tomato, peppers and grapes is 5–10, 25–30 and 20–25% respectively. Most of the published work on the nutritional value of the above mentioned by-products bring out the energy value and relatively good protein value (Sinovec and Ševković, 1995; Radovanović and Rajić, 1990; Stojanović et al., 1989; Todorov, 1995; Šokarovski and Cilev, 1999). Biological experiments proved their nutritive value and efficiency in nutrition of ruminants (Smilevski et al., 1973, 1975; Damjanovska et al., 1988; Šokarovski et al., 1981; Bogdanov, 1980). Since the demand for pork and poultry is increasing, it is necessary to examine the effect of this by-products in the nutrition in non-ruminants, especially that they compete for food with humans.

That's why it is scientifically justified and practically usefull to examine the effects of the maize substitution with by-products obtain from the manufacturing of the tomatos, peppers and grapes, on the production results and health of the weaned piglets.

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 weaned piglets. 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
The 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
Proteini	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 is much poorer source of energy than corn. An experiment by group control system was carried out and the effects on the productive results and health conditions of the piglets were measured at the producing condition on the pig farm ZZ "Edinstvo", village Chelopek, Tetovo region, R. Macedonia.

The experiment was carried out on weaning piglets about 28–30 days old and average weight of 8.66–8.84 kg. Mongrels were used for the experiment from Swedish and Dutch races with equalized genetic potential. Each group consisted of equal number of males and females.

The experiment of the weaning piglets was carried out on 72 piglets divided into 3 groups, each group consisting of 12 piglets of equal sex proportions. The experiment lasted for 42 days in 2 phases each lasting for 21 days. The weight of the piglets and the amount of consumed feed were measured on a regular basis during the experiment. The weaned piglets were fed with suitable mixture with standard raw and chemical composition (Table 2). Two mixtures were used during the experiment that completely satisfied the needs of the piglets (AEC, 1993; NRC, 1998; Regulation 2000) mixture for weaning piglets for 1–21 days, and mixture for breeding piglets for 21–42 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 weaning piglets, effects the production results and the piglet's health condition and to determine weather it is practical to use mixtures with by-products in the nutrition of piglets. Minimal corrections were made in the mixtures. The experimental piglets from the experimental control group were fed with mixtures not containing any of the above mentioned by-products, whereas the pigs in the experimental groups were fed only with mixtures where maize was substituted with different quantities of the specified by-products. The mixuters included 3 and 6% from the examined by-products in the mixtures for piglets nutrition.

Samples from the feed for analysis were taken at equal time intervals of 30 days during the experiment. Regulation (1987) for the methods of sampling and methods of physical, chemical and microbiological analysis of animal feeds was used.

Control weighing of the experimental animals was done using technical scale that has 10^{-2} kg accurate. Based on those results, the mean weight of animals was calculated. From the difference in the measurings the total weight gain was calculated, while the daily weight gain was calculated based on individual phases of the experiment, as well as the total experiment.

During the experiment the total mixture that was given to particular group of animals was weighted. In the end, based on the sum of the daily mixture that were used, the total expenditure of food was calculated for each phase and the whole experiment. The results on consumed feed and the weight gain of the pigs, the conversion of food was calculated for each phase and the whole experiment.

Beside taking preventive measures, all of the piglets were under veterinary control and every change in medical condition was examined and noted. Daily examination comprised group and individual observations.

Table 2
Composition of mixture for the nutrition of weaning piglets, (%)

Feeds	to 15 kg				from 15-25 kg		
	K	O-I	O-II		K	O-I	O-II
Maize	61.70	58.70	55.70		65.30	62.30	59.30
By product of tomatoes	–	1.00	2.00		–	1.00	2.00
By product of peppers	–	1.00	2.00		–	1.00	2.00
By product of grapes	–	1.00	2.00		–	1.00	2.00
Soya bean meal	22.00	22.00	22.00		21.00	21.00	21.00
Sunflower meal	5.00	5.00	5.00		5.00	5.00	5.00
Fish meal	6.00	6.00	6.00		3.00	3.00	3.00
Soya oil	3.00	3.00	3.00		3.00	3.00	3.00
Limestone	0.50	0.50	0.50		0.50	0.50	0.50
DCaP	1.00	1.00	1.00		1.30	1.30	1.30
Salt	0.20	0.20	0.20		0.30	0.30	0.30
Methionine	0.05	0.05	0.05		0.05	0.05	0.05
Lysine	0.05	0.05	0.05		0.05	0.05	0.05
Premix	0.50	0.50	0.50		0.50	0.50	0.50

Results and Discussion

The chemical content of the mixtures for the weaned piglets in the experiment is shown in Table 3. It can be seen that substituting the maize with by-products from the manufacturing of tomatoes, peppers and grapes insignificantly increases the content of protein, fat and fiber and energy, while the amino acids content remains the same.

The rations and amount of the feeds in the mixture for the experimental piglets were composed using conventional methods used in the practice. The results on the chemical content of the feeds used for the growing piglets in the control group showed that the food was meeting the technological standards and regulations (Regulation, 2000), and so the content of all the nutrients in the mixtures corresponded to the needs of the different categories of pigs in the different phases of the experiment (NRC, 1998; AEC, 1993). The chemical analysis confirmed the balance in the content of different amino acids (lysine, methionine, treonine and tryptophane) in the mixture for the animals in the control group. The chemical content, including the amino acids, of the mixtures for the piglets in the experimental groups that had semisubstitution of the maize with by-products obtained from the manufacturing of tomatos, peppers, grapes, didn't differ significalnty from the mixtures for the control groups.

Based on the above, it can be concluded that the chemical content of the used total mixtures for all of the groups of experimental piglets was meeting the needs and corresponded to the demands that were made when the experiment was established.

Table 3
Chemical composition of mixture for the nutrition of weaning piglets, (%)

Chemical composition	to 15 kg				from 15-25 kg		
	K	O-I	O-II		K	O-I	O-II
Moisture	11.32	11.17	11.04		11.45	11.31	11.18
Ash	5.06	5.17	5.27		4.90	5.00	5.11
Proteini	20.18	20.47	20.75		18.17	18.45	18.74
Fat	6.15	6.35	6.55		6.09	6.29	6.49
Fibre	3.80	4.90	6.00		3.80	4.90	6.00
NEM	53.49	51.94	50.39		55.59	54.05	52.48
Calcium	0.98	0.99	1.01		0.85	0.86	0.88
Phosphorus	0.74	0.75	0.75		0.70	0.70	0.71
ME, MJ/kg	14.39	14.43	14.48		14.32	14.37	14.42
Lysine	1.18	1.18	1.19		1.00	1.01	1.01
Methionine+cystine	0.69	0.69	0.69		0.62	0.61	0.61
Threonine	0.28	0.28	0.28		0.26	0.26	0.26
Tryptophane	0.45	0.44	0.44		0.43	0.43	0.43

Table 4
Body weight of weaning piglets in the experiment, (kg)

		Measures of variation					
Groups	n	x	±	Sx	Sd	Cv	Iv
1 day							
K		8.66		0.21	1.05	12.16	7.00–11.00
O-I		8.79		0.20	0.99	11.36	7.00–10.60
O-II		8.84		0.19	0.94	10.58	7.20–10.50
21 day							
K		15.04		0.86	2.74	19.38	10.30–17.80
O-I		14.80		0.79	2.51	17.96	8.70–16.70
O-II		14.01		0.80	2.52	19.14	9.30–16.30
42 day							
K		26.98		0.80	3.92	14.53	17.00–34.00
O-I		27.37		0.72	3.51	12.83	18.50–34.00
O-II		26.02		0.87	4.26	16.39	13.00–31.00

The piglets in every group had uniform body structure, well formed bone and muscle tissue, vivid temper and were in good condition. The hair, skin and visible mucous membranes had no changes. Apetite was good, and the stool was normal. The ability for active movement and coordination of movement were well-balanced and the muscle tone was normal. During the experiment the health of the piglets was not affected and no disease or mortality was noted.

At the beggining, the piglets in all of the experimental groups had uniform body weight, and the differences between groups were not statistically significant (Table 4). At the middle of the experiment the experimental groups had slightly lower body weight compared to the control group, and the piglets in the group O-II had the lowest body weight. At the end of the experiment the piglets from all of the groups had almost the same body weight, and the piglets in group O-I had slightly higher body weight compared to the control group. The differences between the groups were not statistically significant ($p > 0.05$). Based on this results it can be already concluded that the used treatmets didn't affect the body weight.

The average daily gain in mass in each group of the experiment had differences between the groups and in different phase (Table 5). The highest daily gain in weight in the first phase of the experiment was achieved by the control group, the lowest by the O-II group, the results being statistically significant ($p < 0.05$). In the second phase of the experiment, the piglets of the two experimental groups increased their weight gain, but the results were not statistically significant ($p > 0.05$). The weight gain in the whole experiment was slightly higher for the O-I group, and slightly lower for the O-II group, when compared to the control group. Although the numbers show differences, the statistical anlysis concludes that the differences between groups in weight gain were not statistically significant ($p > 0.05$).

Although the body weight is a good indicator for the quality of the nutrition, the daily gain is considered more accurate (Figure 1). From the data analysis it can be concluded that in both phases, the piglets in the control group that were fed with mixtures with standard raw material had an average daily gain of 0.436 kg. It is thought that feeding standard mixtures gives staisfying results on the production, and the pigs have a daily gain of 373 g (Kovčin and Pejić, 1988) to 383 g (Waaijenberg, 1987), and 0.340–0.387 kg Dabetić (1999), but in practice it has been measured (Puača, 1970; Grujić, 1998) even higher daily gains (0.415–0.430 kg).

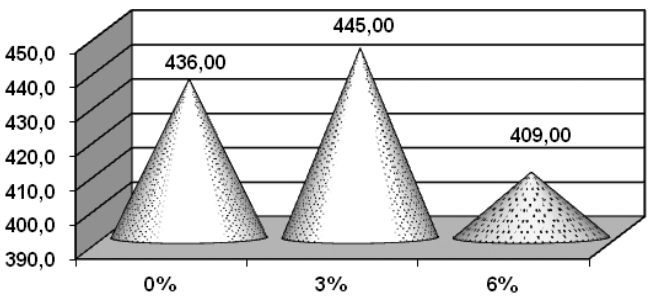

Fig. 1. Daily gain [g]

The piglets in the both experimental groups had a lower weight gain compared to the control group, and the differences for the O-II group were statistically significant ($p < 0.05$). In the second phase of the experiment, the piglets in both experimental groups had slightly higher weight gain, but the differences were not statistically significant ($p > 0.05$). Talking about the whole experiment compared to the control group,

Table 5
Gain of weaning piglets in the experiment, (kg/day)

		Measures of variation					
Groups	n	x	±	Sx	Sd	Cv	Iv
1–21 day							
K		0.304	[a]	0.01	0.01	11.41	0.205–0.422
O-I		0.286		0.02	0.05	12.28	0.185–0.410
O-II		0.246	[b]	0.03	0.08	15.35	0.185–0.380
21–42 day							
K		0.568		0.02	0.07	15.03	0.411–0.713
O-I		0.598		0.02	0.06	12.80	0.393–0.711
O-II		0.572		0.02	0.09	16.71	0.456–0.723
1–42 day							
K		0.436		0.01	0.06	13.32	0.337–0.504
O-I		0.445		0.02	0.06	14.71	0.309–0.564
O-II		0.409		0.03	0.07	15.33	0.382–0.521

[a, b] $p < 0.05$

the piglets from the group O-I had slightly higher, and the piglets from the group O-II slightly lower results in weight gain, and the analyis shows that the differences were not statistically significant ($p > 0.05$).

The average daily consumation of feed is shown in Table 6. The piglets of the control group consumed the same amount as would in practice, and the same applied to the piglets in the first experimental group O-I. Increasing the percentage of the by products in the mixture had negative effect on consumation of feed by the piglets in the group O-II, both in different phases, and the whole experiment.

Table 6
Consumption of feed in the experiment, (kg/day)

	Groups		
Phase of experiment	K	O-I	O-II
	Weaning piglets		
1–21 day	0.452	0.452	0.382
Index	100.00	99.78	84.51
21–42 day	0.865	0.890	0.820
Index	100.00	102.09	94.60
1–42 day	0.658	0.671	0.601
Index	100.00	101.98	91.34

The apetite is a first indicator of the health of the animal and the quality of nutrition. The average daily consumation of feed varied between groups, especially between the experimental groups. The piglets in the control group that were fed with mixtures of standard composition of raw materials consumed the same amount that is standard for the pigs in practice, from 0.626 kg (Waaijenberg, 1987), 0.649–0.665 kg (Dabetić, 1999) to 0.760 kg (Kovčin and Pejić, 1988), and 0.790 (Puača, 1970), but some noted (Grujić, 1998) much higher values (0.941 kg) (Figure 2).

The piglets from the experimental groups consumed different amount of food, and the increase of the by products in the mixture decreased the consumation of food that applied to both phases, and the whole experiment.

Food conversion as well as the interaction of the growth and consumation of food, was different between the groups and in different phases, and between the experiments (Table 7). The pigs in both of the experimental groups had lower conversion in the first phase and higher conversion in the second phase of the experiment. For the whole experiment the experimental groups had conversion that was lower by 1.97 and 2.64 respectively.

Table 7
Conversion of feed in the experiment, (kg)

	Groups		
Phase of experiment	K	O-I	O-II
	Weaning piglets		
1–21 day	1.49	1.58	1.55
Index	100.00	106.04	104.03
21–42 day	1.52	1.49	1.43
Index	100.00	98.03	94.08
1–42 day	1.51	1.50	1.47
Index	100.00	99.34	97.36

Food conversion, as an interaction of weight gain and feed consumation, is a resultant that at the end is the best indicator of the profitability of the production, which means the quality of nutrition and its ability to meet the specific and high needs for growing young animals. The piglets in the control group that were fed with mixtures of standard composition of raw materials achieved a conversion that is standard for the pig industry: from 1.63–1.81 kg (Waaijenberg, 1987; Puača, 1970), and 1.69–1.95 kg (Dabetić, 1999), as much as 2.05–2.18 kg (Kovčin and Pejić, 1988; Grujić, 1998). The growing piglets of the two experimental groups had a lower conversion in the first phase of the experiment, while the conversion in the second phase was better. Talking about the whole experiment, the experimental groups had almost identical food conversion (Figure 3).

Summing the results of the whole experiment, it can be stated that the semisubstitution of maize with by products obtained from the manufacturing of tomatoes, peppers and grapes, especially of 3%, has no negative effects on the production results of the weaning and growing piglets.

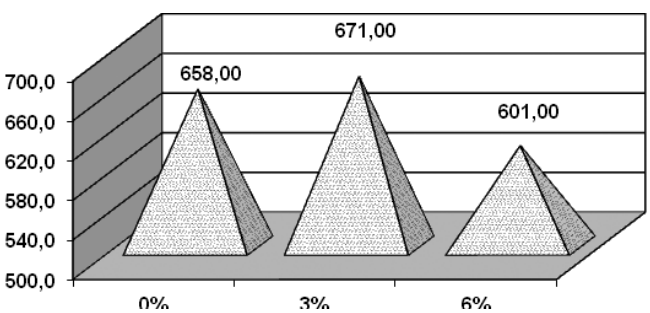

Fig. 2. Comsumption of feed, (kg)

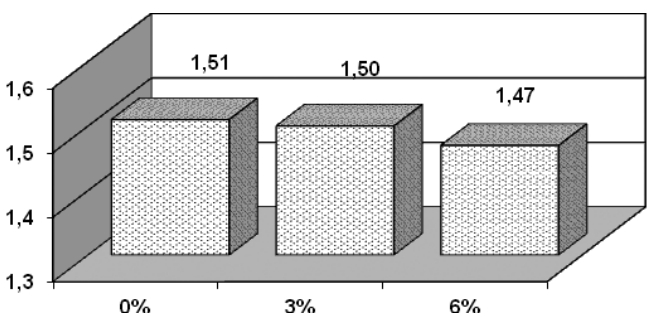

Fig. 3. Conversion of feed, (kg)

Conclusions

Based on the results from the examination of the possibilities for substitution of maize, as energetic feed, with by products obtained from the manufacturing of tomatoes, peppers and grapes in the nutrition of weaning and growing piglets over the production results and health it can be concluded that:

Semisubstitution of maize with by products obtained from the manufacturing of tomatoes, peppers an grapes, especially of 3%, has no negative effects over the production results of the weaning and growing piglets.

As a whole, the applied treatments do not negatively affect the production results and the health condition of the different categories of pigs, which advocates the semisubstitution of the maize with by products obtained from the manufacturing of the tomatoes, peppers and grapes.

References

AEC, 1993. Recommendation for animal nutrition. *Rhone-Poulenc, Animal Nutrition*, France.

Bogdanov, P., 1980. Effects of using of by-product from tomatoes in intensive fattening of early weaned lambs. *Krmiva*, **12:** 264–268.

Collier, B. and B. Hardy, 1986. The use of enzymes in pig and poultry feeds. *The Feed Compounder*, **6** (4): 28–30.

Cowan, W. D., 1995. Enzymes for the pig feeds. In: Enzymes for the Industry country/town/Pupl. house.

Dabetić, Đ., 1999. Influence of using enzymes in different type of ration in piglet nutrition on productive results and health. *Fakultet Veterinarske Medicine*, Beograd.

Damjanovska, M., N. Jordanoski, J. Kostadinova and J. Šokarovski, 1987/88. Influence of dry seeds for grape on production results in fattening steers. Godišen Zbornik na Zemjodelsko-šumarski Fakultet, Kniga XXXIV, Skopje, pp. 139–146.

Easter, R., 1995. Energex L in a maize-soya-based piglet diet in the USA 1988. In: Enzymes for the Industry, *University of Illinois*, USA.

Graham, H., 1996. Enzymes for maize-soya pig diets. *Feed International*, **17**: 14–18.

Grujić, R., 1998. Effect of using enzymes in piglet nutrition on productive results and health. *Fakultet Veterinarske Medicine*, Beograd.

Inborr, J., 1989. The use of supplementary enzymes in pig nutrition. In: Procedings of the 25th Annual Nutrition Conference for Feed Manufactures, Guelph, Ontario, Canada, pp. 32–44.

Inborr, J., 1989a. Enzymes in combination. *Feed International*, **10**:16-27.

Inborr, J., 1990. Practical aplication of feed enzymes. *Feed Compounder*, **35**: 42–47.

Kovčin, S. and N. Pejić, 1988. Full fat soya in animal nutrition. *Krmiva*, **30**: 177–183.

NRC, 1998. Nutrient requirements of swine. *National Academy of Sciences*, Washington DC.

Officer, D. J., 1992. Feed enzymes – how should they be used? In: Wollongbar big Industry Seminar, N.S.W. Agriculture, pp. 53–54.

Partridge, G., 1997. Enzymes in pig feeds. 3rd East/West Feed Industry Conference and Exhibition, Prague, Czech Republic.

Puača, V., 1970. Influence of hidrotermical treatment of corn with water vapor on composition and efficiency in piglet nutrition. *KRMIVA* 12, 1970, Zagreb, **10**: 217–224.

Radovanović, T. and I. Rajić, 1990. Practicum in nutrition of domestic animals, *Agronomski fakultet*, Čačak.

REGULATION, 1987. Regulation for the methods of sampling and methods of physical, chemical and microbiological analysis of animal feeds. *Official Gazette SFRY*.

REGULATION, 2000. Regulation for quality and other requirements for food animals. *Official gazette FRY*, 2000.

Rotar, I. and K. Salobir, 1987. Der einfluss des enzymzuzatzes im futter auf den zuwachs und den futterverbrauch bei fruhabgestezten ferkeln. Zbornik Bioteh. Fakul. v Ljubljani, Kmetijstvo, Zivinoreja, **50**: 121–131.

Sinovec, Z. and N. Ševkovic, 1995. Practicum in nutrition, *Veterinarski Fakultet*, Beograd.

Smilevski, S., J. Šokarovski, R. Ilkovski and T. Tokovski, 1975. Dry seeds for grape in ruminants nutrition 1. Dry seeds for grape in nitrition of fattening steers. Godišen Zbornik na Zemjodelsko-šumarskiot Fakultet, Skopje, **26**: 167–172.

Smilevski, S., J. Šokarovski, R. Ilkovski, T. Tokovski, D. Lazarevska and A. Trajkovski, 1973. Dry seeds for grape in ruminants nutrition. 2. Dry seeds for grape in nitrition of dairy cattle, Jubileen Godišen Zbornik po povod 25-godišninata od Zemjodelsko-šumarskiot Fakultet, Skopje, **25**: 17–24.

Smilevski, S., J. Šokarovski, T. Tokovski, D. Lazarevska and R. Ilkovski, 1973. Dry seeds for grape in ruminants nutrition. 1. Dry seeds for grape in nitrition of sheep. Jubileen Godišen Zbornik po povod 25 godišninata od Zemjodelsko-šumarskiot Fakultet, Skopje, 25, 25–31.

Stojanović, S., T. Stojsavljević, N. Vučarević, M. Vukić-Vranješ and A. Mandić, 1989. Chemical composition and nutritive value of dry seeds for grape in animal nutrition. *Stočarstvo*, **43** (7–8): 313–319.

Šokarovski, J. and G. Cilev, 1999. Evaluation of feedstuffs for animal nutrition. Final report of Project – Ministry of Education and Science.

Šokarovski, J., N. Kozarovski, N. Popovski, N. Jordanoski and M. Damjanovska, 1981. Barley, dry seeds of grape and dry beet sugar like supstituents of corn in nutrition to fattening lambs. ZBORNIK RADOVA Poljoprivrednog Fakulteta, Univerziteta u Beogradu, 27–28, 587, pp. 45–50.

Todorov, N., 1995. Recommendations of nutrition for cattle and buffalo. *Stara Zagora*, Bugaria.

Waaijenberg, S., 1987. Feed formulation with fullfat soya the economic of its use. Fullfat Soya, Regional Conference, Milan, Italy.

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