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Effects of differently treated soya-bean as a component in broiler feeds

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I. – Introduction

Out of about 2,7 million agricultural holdings in Yugoslavia, 1,9 million grow maize. Therefore, the basis of all mixed feeds for poultry, either for industrial production of meat or eggs of for local production on holdings, is maize, with a share from 50% to 90%. However, in the production of poultry feeds the difficulty is the supply of protein components, such as soyabean meal or fish meal. While large scale production is more or less well stocked with these ingredients, farmers growing their own maize have difficulty in overcoming this problem.

Many studies have shown that properly prepared whole unextracted soyabean can be an effective ingredient for all types of diets for broilers, laying hens and turkeys. Trials have also shown that in many maize growing areas, soyabean can be grown with maize, complementing it both culturally and nutritively. Many holdings grow soyabean in addition to maize and use it in different ways. As the effectiveness of using proteins and energy in soyabean depends on the technology of preparing it, we examined the effectiveness of some methods of preparing soyabean in diet combinations of maize - soyabean.

II. – Material and methods

Raw soyabean of the Hodgson variety grown in the region of Zemun Polje, of determined chemical properties, was thermically processed in several ways : roasted with continual mixing of the beans, cooked in a pressure cooker, type of a cooker under 1 at^{m}, after soaking the beans, and infra red cooking using a micronizing machine.

After heat treatment, the raw and treated beans were ground in a mill with a 3 mm mesh, and then all samples were tested for trypsin inhibitor content (**Table 1**).

Four diets were made from the raw and heat treated soyabean meal, which differed only in the type of heat treatment. A fifth diet was also made, where the full fat soyabean was replaced by the standard soyabean meal, i.e. equivalent part of the soyabean protein (**Table 2**).

With the prepared diets, four groups of Prelux-Bro broilers were fed 56 days, and weighed every 14 days. After fattening, the killing out data were taken : the size and mass of the pancreas, and after chilling, yield, abdominal fat, roasting loss and conformation measures of carcass of typical broilers. The measuring of different body dimensions, i.e., conformation measures, was made after the method of Pavlovski and Mašić (1983). Standard yields (standard dressing, ready for roasting and grilling) were determined according to official regulations.

Roasting loss was determined using breast and drumstick meat. After weighing the meat was roasted at a temperature of 200°C for seven minutes on one side and five minutes on the other side. The meat was weighed again after roasting. Roasting loss was calculated as follows:

$$\frac{\text{mass of meat after roasting}}{\text{mass of meat before roasting}} * 100\ \%$$

III. – Results and discussion

The established content of 53.2 TIU is considered as the most significant factor inhibiting the nutritive and biological potential of full fat soyabeans. It was found that all investigated types of heat treatment significantly reduce the trypsin inhibitor activity. Of the initial value of 53.25 TIU in the raw bean, after roasting, cooking and micronizing the activity was reduced to 2.98, 3.56 and 2.66 respectively, while in standard soyabean meal it was found to be 4.41 TIU. As in trial diets, analogous quantities of 34% of raw soyabeans were included, it means that diet A with raw soyabean contained 18 to 20 times more inhibitor activity, expressed per kilogram of mass.

- **Broiler gain.** The finish mass of broilers fed raw soyabean which was roasted, cooked or micronized was 21.8%, 17.8%, 8.9% and 3.3% less, respectively, compared to broilers fed standard soyabean meal diet. Testing of differences between treatments showed that there were no significant differences in gain between soyabean meal and micronized bean ; compared with cooked soyabean, the difference was significant ; and compared to the treatment with roasted and raw soyabean, it was very significant. There were no significant differences between micronized and cooked soyabean, but micronized soyabean produced a significantly higher gain compared to the gain with roasted and raw soyabeans. Beween these two treatments, there were no statistically significant differences. It was then found that the average mass of broilers did not surpass in any treatment the gain in broiler mass of the control group, but also that this last group was closely followed by the group fed on micronized soyabean diet, while broilers on cooked soyabean diet were not so far from the control group.

- **Feed consumption.** When treatments are compared according to the consumption, i.e. feed conversion for the whole feeding period, results show that the group of broilers fed micronized soyabean diet had the best feed conversion. The feed consumption per kg of gain for this group was 2.09, and 10.0% lower compared to the group of broilers fed soyabean meal. A 4.5% lower feed consumption per kilogram of gain compared to the control was also found in broilers fed roasted and cooked soyabean. The worst conversion rate was in the group fed raw soyabean diet.

- **Gain dynamics.** The analysis of results on the average gain of broilers by growth phases that broilers in treatments with roasted and raw soyabean had the lowest rate of gain. The rate of gain of these groups during the first two weeks was only 54.4% and 58.8% respectively, of the gain of broilers fed soyabean meal. With ageing, broilers fed these diets improved to a certain level the rate of gain, however their lagging compared to broilers in other treatments continued and was very significant.

- **Hypertrophy of the pancreas.** As an effect of the activity of soyabean trypsin inhibitor in the feed, changes occurred in the size, mass and functioning of the pancreas. Both this effect and these changes were highest in the first three weeks. As the mortality rate of the broilers was insignificant, the broilers were fed the whole period and the pancreas was weighed after killing. Results for pancreas mass are given in **Table 5.**

Pancreas mass ranged from 2 to 7 g with a high variation within the same group as well as between groups. The highest average pancreas mass of 5.1 g was found in broilers fed raw soyabean, which is 1 g over the pancreas mass of broilers fed soyabean meal. It is characteristic that the average pancreas mass

was lowest in broilers fed roasted and micronized soyabean. Broilers from these treatments had the lowest pancreas mass compared to the average body mass.

☐ **Conformation measures** of carcasses of typical chickens (**Table 6**) show that the average live mass of male birds ranged from 1,325 g (raw soyabean) to 1,930 g (control). The best average breast angle was found in broilers of the control group. By nature of the breast angle, differences are negligible, because all values indicate good and similar conformation (instrument ZP-3) measurement range 60-130 deg). As the higher the relative length of the shank (expressed by the index g/mm) the higher the index, from the standpoint of conformation, the best conformation was found in the control group and worst in the group under treatment A. Keel length, as a conformation factor, has two contradictions: the longer the keel, the more space for breast muscles, at the same time reducing body roundness. If meatiness has priority (i.e. content) and not the body form, a relatively longer keel would be advantageous. In this case, a lower value of the index g/mm shows a more favourable conformation. It was lowest in broilers of the A group, and highest in broilers of the C group (cooked soyabean). The relative depth of the breast, expressed by the index g/mm (the greater this index the more favourable the conformation), was lowest in B group broilers (roasted soyabean), and highest in both sexes of C group. Drumstick circumference is higher in broilers with round drumsticks. The relative circumference of the drumstick, expressed by the index g/mm (the lower this index the better the conformation), was lowest in A group broilers of both sexes.

Then, of the investigated groups of broilers, the most favourable conformation was found in group A broilers, which can be related to their lower live mass.

Table 7 shows that carcass dressing percentages did not differ between the investigated groups, as these are related to broiler live mass. The highest average percent of abdominal fat was found in broilers of groups C and B. The highest roasting loss was found in group A broilers, and the lowest in the control group.

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Table 1: The trypsin inhibitor(1) content in raw and differently treated soya bean samples of HODGSON variety

Treatments	TIU(2) per mg dry matter sample
A - Raw soya bean seed meal	53.25
B - Roasted soya bean meal	2.98
C - Cooked (under pressure) soya bean meal	3.56
D - Micronized (IRP) (3) soya bean meal	2.66
Control/Standard soya bean meal - 44% protein	4.41

(1) Obtained by the method: Kakade-Simons-Liener, Cereal Chemistry 46:518 (1969).

(2) One TIU is arbitrarily defined as an increase of 0.01 absorbance units at 410 mm per 10 ml of reaction mixture under the conditions set in the method.

(3) IRP = Infra-Red-Process, known as micronization.

Table 2: Structure and chemical composition of test mixtures with different thermal treatment of soya bean

Composition in %	Treatments				
	A	B	C	D	Control
Ground maize	58.5	58.5	58.5	58.5	62.5
Fish meal (1)	4.0	4.0	4.0	4.0	4.0
Min. vit. suppl.	3.5	3.5	3.5	3.5	3.5
Ground soya bean seed					
Raw	34.0	-	-	-	-
Roasted	-	34.0	-	-	-
Cooked	-	-	34.0	-	-
Micronized-IRP	-	-	-	34.0	-
Soya bean meal	-	-	-	-	30.0
Total	100.0	100.0	100.0	100.0	100.0
Crude protein, %	20.7	20.6	19.8	20.9	20.8
Crude fat, %	9.3	9.6	8.8	8.9	3.3
Crude fiber, %	2.7	2.7	2.5	3.2	3.1
Ash	4.3	4.6	4.2	4.3	4.7
TIU per kg (2)	18,105	1,013	1,210	904	1,323

(1) After 28 days, changed with same percent of meat meal.

(2) Trypsin Inhibitor Units (see **Table 1**).

Table 3: Average chicken weight and its variation

	Treatments				
	A	B	C	D	Control
Finished chicken					
Weight, g	1 328 c	1 396 c	1 546 b	1 641 ab	1 697a
SD	154	132	156	176	220
CV	12	10	10	11	13
Average weight index	78.2	82.2	91.1	96.7	100
Food conversion	2.54	2.21	2.22	2.09	2.32
Conversion index	109.4	95.2	95.6	90.0	100

SD = Standard deviation.

CV = Coefficient of variation.

a, b, c : Figures with the same letter were not significantly different.

Table 4: Dynamics of average chicken gain by two week periods and food consumption per kg of gain

Treatments	Average gain in grams				
	0-2 Weeks	2-4 Weeks	4-6 Weeks	6-8 Weeks	0-8 Weeks
"A"	146	324	349	448	1 297
"B"	136	277	352	567	1 332
"C"	221	335	435	519	1 332
"D"	216	383	454	540	1 593
Control	250	381	442	553	1 626
Index of gain					
"A"	58.4	85.0	79.0	81.0	79.8
"B"	54.4	72.7	79.6	100.0	81.9
"C"	88.0	87.9	98.4	93.5	92.8
"D"	86.4	100.0	102.0	100.0	97.8
Control	100.0	100.0	100.0	100.0	100.0
Food consumption per kg of gain, kg/kg					
"A"	1.95	2.94	2.32	2.47	2.54
"B"	2.21	2.15	2.29	2.25	2.21
"C"	1.49	1.68	2.12	2.36	2.22
"D"	1.49	1.46	1.82	2.18	2.09
Control	1.56	1.97	2.25	2.40	2.36
Conversion index Control = 100					
"A"	125	98.4	103.1	103.0	107.0
"B"	124	109.0	101.7	93.7	93.6
"C"	95.5	85.2	94.0	98.3	94.0
"D"	95.5	74.1	80.8	96.8	88.5
Control	100.0	100.0	100.0	100.0	100.0

Table 5: Ratio of pancreas weight and average chicken weight and weight of slaughtered chicken after 56 days feeding with unextracted soya bean treated differently

Indicator	Treatments				
	A	B	C	D	Control
Average chicken weight, g	1 328	1 396	1 546	1 641	1 697
Average weight of slaughtered chicken	1 102	1 168	1 293	1 393	1 408
Weight of pancreas (g) extremes	3-7	2-5	3-6	2-6	2-4
Average weight of pancreas, SD, g	1.25	0.87	0.85	0.97	0.71
Weight of pancreas in % of average chicken weight	0.38	0.22	0.26	0.22	0.24

Table 6: Conformation measures of the carcass of typical chicken

Group	Sex	Average live mass, g	Length of shank			Length of keel			Depth of breast			Circumference of drumstick			Breast angle, degrees
			mm X	live g/mm	wt.	mm X	live g/mm	wt.	mm X	live g/mm	wt.	mm X	live g/mm	wt.	
Control	Males	1 930	93.00	20.75		102.67	18.80		100.33	19.24		135.33	14.26		94.67
	Females	1 611	84.33	19.10		90.33	16.72		96.67	16.66		129.00	12.49		89.33
A	Males	1 325	77.33	17.13		88.00	15.06		86.67	15.29		217.33	11.29		85.00
	Females	1 241	80.33	15.45		82.67	15.01		86.67	14.32		113.33	10.95		81.67
B	Males	1 419	83.00	17.10		87.67	16.19		95.00	14.94		107.67	13.18		73.00
	Females	1 304	74.67	18.19		87.33	14.93		87.33	14.93		110.33	11.82		94.00
C	Males	1 671	83.00	20.13		89.00	18.78		96.33	17.53		129.67	12.89		84.67
	Females	1 494	79.67	18.75		90.67	19.68		88.00	16.98		107.33	13.92		94.00
D	Males	1 557	79.67	19.54		91.00	17.11		89.93	17.31		124.00	12.56		91.00
	Females	1 530	79.33	19.29		86.00	17.79		86.33	17.72		122.67	12.47		96.00

Table 7: Dressing percentage, abdominal fat, roasting loss of typical chicken

Group	Sex	Carcass mass in % of live mass			Abdominal fat in % of live mass	Roasting loss, %	
		Dressing percentage X	Ready for roasting X	Ready for grilling X		Drumstick meat	Breast meat
Control	Males Females	80.50 80.18	73.42 72.17	62.87 63.41	0.68 0.78	26.62 30.55	19.30 22.28
A	Males Females	80.84 81.78	70.49 72.20	62.33 63.92	1.30 1.76	35.21 37.95	31.70 30.40
B	Males Females	80.69 81.79	69.96 71.93	60.95 63.42	1.21 2.10	34.48 37.20	28.80 26.59
C	Males Females	80.26 78.55	69.99 69.22	61.29 60.72	1.34 0.78	32.84 36.66	25.53 24.53
D	Males Females	82.01 80.81	72.00 70.96	63.60 62.19	1.63 1.28	34.22 33.76	26.37 25.19