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EFFECT OF FEEDING HEAT-TREATED FULL-FAT SOYBEANS ON CARP PERFORMANCE

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INTRODUCTION

Carp is one of the most important fish cultivated in the world todays. It is an omnivoreus that fed on various feeds of plant and animal origin. Soybean meal is used as component in feed mixture for intensivly growing carp. Raw full-fat soybean (FFSB) contain trypsin inhibitor that form irreversable stoichiometric compound with trypsin. Raw FFSB not only inhibit growth and reduce protein digestiblity, but also depress metabolizable energy and fat absorption cause pancreatic hypertrophy and reduce amino acids, vitamins and minerals availablity (Rackis , 1974). Autoclaving or heat processing of raw soybeans destroys the trypsin inhibitor (NRC, 1983). Heat - treated FFSB have been succesfuly used in trout feeding (Sandholm et al., 1976, Reinitz et al., 1978). In carp, the most favourable results in body gain and body protein retention were obtained with the gently and intensely hydrothermally or in intensly thermally treated soybean meal (Abel et al., 1984).

The aim of this study is to find out the optimal heat treatment (temperature and duration) of FFSB when used in fish diets and its effect on fish performance particualrly in species found in tropical warm water.

MATERIAL AND METHODS

Fish meal, soybean meal, FFSB, wheat bran, dry brewers grains were the ingredients used for diets formulation. The actual chemical composition of these ingredients **(Table 1)** was done according to A.O.A.C. (1980). FFSB were subjected to dry heat or autovlaving.

Treatment	Temp.°C	Duration (m.)
Dry heat (hot air oven)	118	0.5
Dry heat (hot air oven)	118	2.5
Autoclaving	96	15.0
Autoclaving	96	30.0

Diets formulation and composition

Soybean meal (SBM), FFSB treated by four methods as above and raw FFSB were used in formulating six experimental diets. All diets were isonitrogenous and isocaloric **(Table, 2)**.

Housing

Six glass aquaria measuring 85 x 40 x 35 cm, about 120 liters capacity were used. Each one was supplied with an air pump, tap water was used which was treated with sodium thiosulphate as antichlor agent at rate of 6.99 mg/liter (Boyd, 1979). Throughout the experimental period the temp. was 26 + 1.2 and Ph was 7.5 + 0.5 which is the optimal recommended for carp rearing.

Fish

Carp fingerlings were obtained from El-Abassa Fish Hatchary. They were devided into six groups each of 15 fish. The average initial body weight was 3g, while the initial length was 6.5 cm.

Feeding regime

Diets components were thoroughly mixed, pelleted and used for the feeding trails. Fish were fed twice daily at a rate of 3% of body weight (Marek, 1975) which was adjusted in accordance to body weight changes during the 8 weeks experimental period.

Performance parameters

All fish of each group were weighed weekly, also standerd lenght was measured, while weight gain and growth rate were calculated according to Winberg (1960).

Body compostion: At the end of the experimental period, all alive fish in each group were killed, whole body was dried, ground and prepared for chemical analysis according to A.D.A.C. (1980).

Histopathological examination: Speciements from the first part of the small intestine and liver were taken from each group and fixed in 10% formalin solution, dehydrated, cleaned and embeded in paraffine blocks then sectioned at 5 micron, stained by haematoxylin eosin stain (Carlton et al., 1967).

RESULTS AND DISCUSSION

Fish performance:

The weight gain, protein efficiency ratio and growth rate of fish fed the control diet were superior to those of fish fed either raw or heat treated FFSB (Table, 3). The control group showed weight gain of 4.3 g. Within the experimental groups, these parameters were better with long duration of heat treatments either dry or autoclaving. The lowest values were found in gorups fed raw FFSB, dry heat

Table(1) Nutrients content of experimental diets

Ingredients %	Moisture	CP	EE	Ash
Fish meal	7.8	66.5	6.5	16.0
Soybean meal	10.8	44.0	1.2	6.1
Full-fat soybean	11.0	34.3	18.2	7.0
Wheat bran	10.9	16.1	1.5	6.8
Dry brewers grains	11.0	23.6	3.0	9.6
Yellow corn	10.4	8.9	3.1	1.3

Table (2) Calculated experimental diets used in different trails (%)

Ingredients %	Basal diet (control)	Full-fat soybean treatments				Raw full-fat soybean
		Dry heat 118C		Autoclaving 96C		
		0.5 min	2.5 min	15 min.	30 min.	
Soybean meal	28	—	—	—	—	—
Full-fat soybean	—	26	26	26	26	26
Fish meal	20	20	20	20	20	20
Wheat bran	20	20	20	20	20	20
Yellow corn	24	20	20	20	20	20
Dry brewers grain	—	10	10	10	10	10
Soya oil	4	—	—	—	—	—
Mineral mix.*	2	2	2	2	2	2
Vitamin mix.**	2	2	2	2	2	2
Total	100	100	100	100	100	100
Calculated analysis (%)						
CP	30.96	29.6	29.6	29.6	29.6	29.6
EE	6.66	7.25	7.25	7.25	7.25	7.25
Ash	6.56	7.6	7.6	7.6	7.6	7,6
CF	4.45	5.55	5.55	5.55	5.55	5.55
Ca	1.11	1.14	1.14	1.14	1.14	1.14
P	1.16	1.19	1.19	1.19	1.19	1.19
ME Kcal/Kg	3559.6	3538,7	3538.7	3538.7	3538.7	3538.7
Cal/protein ratio	114.9	119.5	119.5	119.5	119.5	119.5

*This premix was prepared by mixing 50% dicalcium phosphate(25%Ca,18%P)+ 25 Ramecal trace element premix+25%NaCl. Each Kg contains:Ca 125g,P90g, Fe 25000mg,Cu 2000mg,Mn 6000mg,I 200my,Se100mg,Zn 40000mg,NaCl 250g.

**Each Kg contains:Vit.A4000000IU,Vit.D8000IU,Vit.E 1000mg,Vit.$B_1$2000mg Vit.$B_2$10000mg,Vit.$B_6$1000mg,Vit.$K_3$1000mg,Vit.B_{12} 3mg,Vit.C 10mg,Folic acid 500mg,Pantothenic acid 500mg and 5000mg Niacine amide

Table (3) Carp fish performance fed on differently heat treated FFSB

	basal diet (control)	Full-fat soybeans treatments				Raw full-fat soybean
		dry heat 110C		autoclving 96C		
		0.5 min	2.5 min	15 min	30 min	
Initial weight g	9.29	9.0	9.5	9.63	10.38	8,35
	± 0.9	1.68	1.04	.33	0.88	0.94
Final weight g	13.6	10.34	11.63	10.70	12.60	9.70
	± 3.61	3.06	3.61	2.43	4.51	0.51
Weight gain g	4.3	1.34	2.13	1.07	2.22	1.35
Daily weight gain g	0.08	0.024	0.038	0.019	0.04	0.024
Daily feed intake g	0.495	0.47	0.49	0.47	0.53	0.38
Daily protein intake g	0.15	0.14	0.145	0.14	0.16	0.112
Protein efficency ratio	0.53	0.17	0.26	0.14	0.25	0.21
Growth rate	0.67	0.25	0.36	0.18	0.35	0.27
Initial lenght in Cm	6.68	6.78	6.57	6.56	6.64	6.31
	± 1.09	1.03	1.63	0.75	0.72	0.62
Final lenght in Cm	7.41	7.61	7.43	7.10	7.48	6,42
	± 0.76	0.95	0.76	0.93	0.67	0.45

Table (4)Mortality percentage in carp fish fed on differently heat treated FFSB

	Basal diet (control)	Full-fat soybean treatments				Raw full-fat soabean
		dry heat		Autoclaved		
		0.5 min.	2.5 min.	15min.	30min.	
Initial number of carp fingerlings	15	15	15	15	15	15
Final number	15	10	10	11	13	8
Mortality %	0.0	33.3	33.3	26.7	13.3	46.7

Table (5) Effect of dietary treatments on the whole body composition of carp (%)

Treatments	Dry matter	Cruce protein	Fat	Ash
Initial	15.9	65.4	16,4	13.9
	± 1.27	1.56	1.13	1.0
Control basal diet	22.15	52.2	23.79	15.62
	± 1.63	11.97	1.54	0.53
Dry heat for 0.5min	17.60	44.80	28.77	19.98
	± 2.39	1.56	1.47	0.48
Dry heat for 2.5min	21.5	45.30	29.29	17.45
	± 1.56	1.13	11.23	1.06
Autoclaving 15min	21.75	45.80	29.07	18.20
	± 2.62	1.27	0.81	0.74
Autoclaving 30min	22.8	48.5	27.4	14.40
	± 2.96	1.13	1.0	0.68
Raw FFSB	21.63	48.0	28.36	12.74
	± 2.08	1.56	0.93	0.45

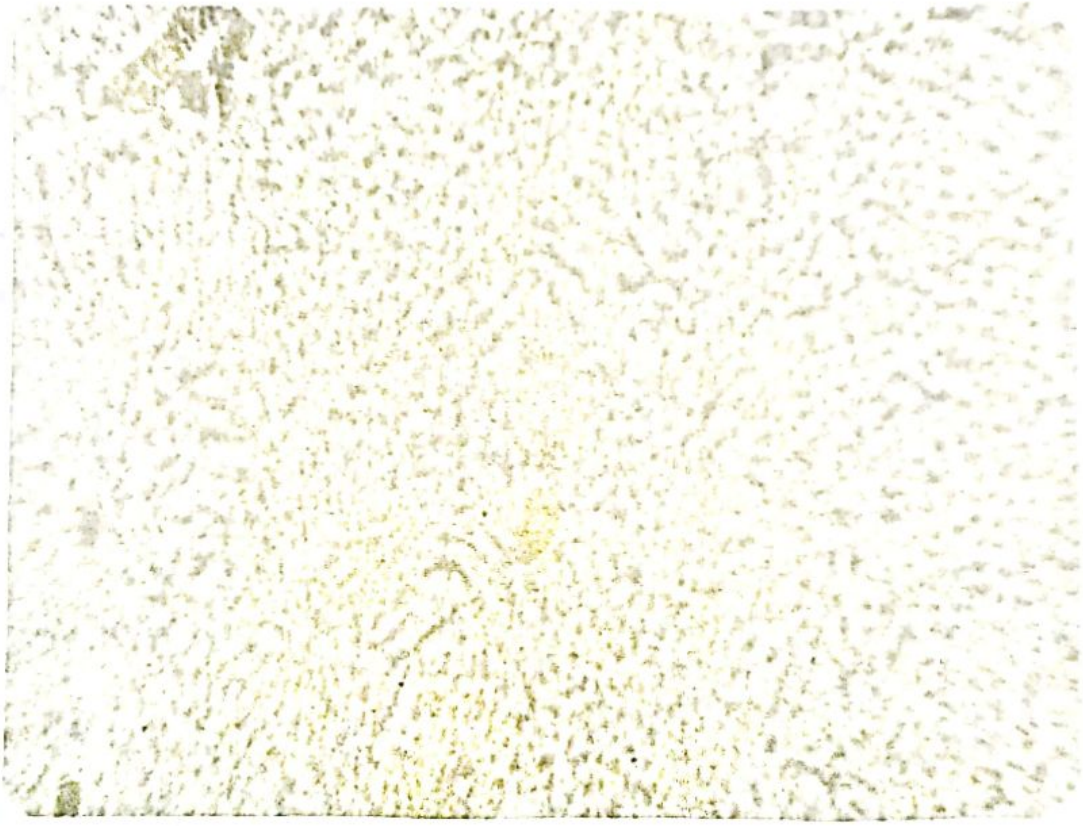

Fig. (1): Liver of fish fed raw FFSB showed sever necrosis

for short period and autoclaved for short period respectivly. These results come in aggrement with that of Abel et al. (1984) who reported best weight gain and body protein retention in carp fed intense thermal and hydrothermal treatment for FFSB. Neverthless, the methods of Abels treatments were different from that used in our study. As the body gain, growth rate and protein efficiency ratio given by the heat treated groups did not acheive that of the the control group, can be attributed to the inadequte time of heat which may lead to incomplet reduction of trypsin inhibitor and urease activity. From the above findings, one can concluded that a more efficient haet treated FFSB will be associated with long time heat treatment.

Body Composition:

The results of chemical analysis of whole fish are presented in **Table (5)**. The highest protein content (52.2%) was found in the fish fed the control diet, while the protein content in the experimental groups was approximetly similar. Concerning the fat content, the control group showed a low fat content than the experimental gorups. The results of high protein, low fat content in the fish fed the control diet indicated an optimal utilization of the dietary protein sources. Regarding the ash content, the ash content of the control and experimental groups was within the normal range.

Mortality rate:

Mortality rate of all experimental groups are presented in **Table (4)**.The control gorup showed 0% mortality, while the group fed raw FFSB showed the highest mortality rate of 46.6%. Within treatments the group fed autoclaved FFSB for long time acheived the lowest mortality rate (13.3). The mortality rate was a mirror for histopathological changes

that had occurred in the liver and intestine of treated groups. The mciroscopical examination reveled in group fed autoclaved FFSB a slight vacculation of hypatocytes in liver, while the intestine was nearly normal. The same treatment for short period reveled slight inflammatory changes in the intestinal wall without necrosis. These results together with of mortality rate,indicated that short duration of autoclaving as a method of heat treatment of FFSB could not overcome the drastic effect of inhibiting substances present in raw FFSB, Liver of fish fed raw FFSB showed vaccular degenerative foccal areas of necrosis, hyperplastic proliferation and showed more severe necrosis (Fig. 1). The intestine of this group showed more severe necrosis, haemorrhes and excessive degenerative changes than all other groups of the treatments.

The results presented here showed that, raw FFSB should not be included in carp diets. The best heat treatment for FFSB was autoclaving for 30 min. regading the performance and mortality, also the hydrothermal methods were more competent in controlling the inhibitory substances present in FFSB regarding Carp feeding.

SUMMARY

In 8 - weeks feeding experiment, carp fingerlings fed raw soybean, heat-treated full-fat soybean (FFSB) dry heat or autoclaving and soybean meal in fish diets to investigate their effect on growth performance (weight gain, growth rate, protein efficiency ratio), mortality rate and whole body composition also for histological changes in liver and first part of intestine. Fish fed the control diet that contained SBM showed the best results regarding the growth parameters, no mortality or histological changes. Fish fed raw FFSB showed low

performance, high mortality rate (46.4%) and drastic pathological changes than groups fed on heat-treated FFSB. It can be concluded that a more efficient method of heat treatment of FFSB when incorporated in carp diets was autoclaving for long perriod as it acheived better performance and lower mrotality, however the soybean meal was the best.

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