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The use of different levels of raw and processed chickling vetch (*Lathyrus sativus*) seeds in broiler nutrition

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In order to evaluate using of *Lathyrus sativa* (LS), abundantly available in Ardebil province, as dietary for broiler a growth study was conducted. The samples of (LS) were prepared from Ardebil regions and analyzed with standard methods. The average of grain dry mater was 93.2 percent, gross energy was 4150 Kcal/Kg, crude protein, crude fat, crude fiber, ash, ca and p were 26.9, 1.35, 6, 4.5, 0.11 and 0.48 percent, respectively. All birds were fed ad libitum an experimental ration. The same management system was adopted for all birds, reared up to 42 day in 21 floor pens on poultry house. The experiment was carried out using factorial method (2×4) in a completely randomized design with four treatments and three replications. First factor was two levels of LS (raw and autoclaved), second factor was four levels of LS (0, 10, 20 and 30%) in diet of standard adjusted as NRC ,1994; and Ross 308 strain that fed to 1113 seven-day old broiler chicks. At the period of starter, ADG and FCR were reduced while at the period of growth ADG was not significantly affected at these levels (P<0.05) and ADG was increased between treatments autoclaved. Daily feed consumption, ADG and FCR were not significantly affected of raw and autoclaved LS treatments. In addition, body weight and the interaction effect between these two factor also were no significantly differenced (P<0.05). The results of the experiment showed that both raw and autoclaved are suitable alternative for soybean meal in broiler nutrition.

Keyword: Autoclave treatment, broiler, *Lathyrus sativa* (LS), nutrition.

INTRODUCTION

Chickling vetch or grass pea (*Lathyrus sativus*) is a leguminous crop cultivated in different parts of the word, its presumed center of origin is southwest and central Asia (smart, 1990). It has a number of advantageous biological and agronomic qualities such as extensive tolerance to draught and water logging, high grain yielding capacity and resistance to insects, pests and potential sources of energy and amino acid. In addition, these seeds are comparatively cheaper than many other legumes (Girma Akalu et al., 1998).

In Iran, Chickling vetch is grown in regions where chickpea and lentils are growing such as Northwest and west. There are no accurate data in Iran cultivation

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regions. In Iran foliage and seeds used for forage and animal feed; the latter also for human consumption.

Variation recorded in the germplasm of Chickling vetch or grass pea (*Lathyrus sativus*) hasn't been greatly utilized in plant breeding to lower levels of anti- nutritional factors (ANFs) with the exception a neurotoxin, 3-(-N-Oxalyl)-L-2, 3-Diamino Propionic acid (ODAP), Leaving considerable potential for rapid improvement of cultivars. Due to the occurrence of Lathyrism in humans resent plant breeding has produced cultivars with low ODAP lines of L.sativus or L.cicera can be safely incorporated at inclusion rates up to 40,30 and 70% of the poultry, pigs and sheep diet, respectively, without growth reductions (Hunbury et al.,2000).

Feeding raw Chickling vetch (LS) to chickens generally results in lower growth rate and reduced feed efficiency compared with feeding processed Chickling vetch. A number of techniques are available for eliminating ANFs, thus improving the nutritional value of Chickling vetch or grass pea (*Lathyrus sativus*). Emphasis is placed on the effectiveness of heat treatment such as autoclaving treatment for improving the nutritional value of Chickling vetch for poultry production (Wiryam et al., 1998). With this consideration in mind, the present investigation with a local variety of *L.sativus* seed was undertaken with the following objectives: (1) To study the effect of heat treatment on ANFs. (2) To assess the effect of *L.staivus* on the biological performance of broiler. (3) To find appropriate inclusion rate of *L.sativus* as an alternative protein source for broiler.

MATERIAL AND METHODS

Preparation of Samples: The seeds of Chickling vetch (LS) were procured from local farmers' Ardebil province, cleaned of dust, dirt or any other foreign material.

***Treatment (Wet* autoclaving):** whole seeds were autoclaved (Getingeverken, Swederi) 121 degrees Celsius and 103 kg/cm^2 pressure for 20 minutes as described by Girma Akalu et al. (1998).

Chemical and Amino acid Analysis: Chemical composition of whole seeds was made according to the methods of (AOAC,2000). The N-Oxalyl α-β-Diamino Propionic acid (ODAP) content was determined through HPTLC method according to Tarade et al. (2007) procedure. Standard ODAP was supplied by Lathyrus Technologies, Hyderabad, India ODAP was extracted, using water and HCL. The acetonitrile was then densitometrically determined at 500 nm on Camag II densitometer. Total extractable Phenolics (TP), Total Tannin (TT) and Condensed Tannins (CT) were determined using folin-ciocalteu reagent, insoluable PolyVinyl PolyPyrrolidone (PVPP) and butanol-HCl method as described by Makkar (2000).The amino acids were determined from ground samples (50mg) after acid hydrolysis under reflux with 50ml 6N HCl acid for 24h at 110oC. The amino acid analysis was performed using an automated precolumn derivatisation with o-phthaldialdehyde (OPA) using reverse-phase HPLC (Model 23250, ISCO, USA).Tryptophan was determined following the procedure described by Fontaine et al. (1998). The contents of the different amino acids recovered were expressed as g per 100g protein. The nutritional quality of LS was evaluated by calculating the chemical index score or protein score according to the Block and Mitchell method (FAO, 1973).

Animal experiment: To assess the toxic effect of chickling vetch (*L.Sativus*) a feeding trial on day old broiler (Ross 308 Strain) was conducted. 7-day old 1272 chicks were randomly divided into 2 main groups. Each mein group will be further divided into 4-sub groups having 159 chicks (3 replicates of 53 chicks) in each sub group. Eight isonitrogenous and isocaloric experimental starter rations were formulated having ME 2981 Kcal/Kg and CP 22.75%. Eight isonitrogenous and isocaloric experimental grower rations were formulated having ME 3100 Kcal/Kg and CP 20.5%. Rations were formulated by using raw (unprocessed) or autoclaved seeds of Chickling vetch. In these rations levels of Chickling vetch seeds were 0, 10, 20 and 30%, respectively. Ad-libitum feed and water was offered to all chicks. All the birds were vaccinated against the important diseases. The studied parameters were feed consumption, weight gain, feed conversation ratio (FCR). Data obtained was statistically analyzed by (2×4) factorial arrangement by using SAS computer program and Duncan multiple range test (DMR) was applied to compare the means (Steel and Torrie, 1982). The chemical and amino acid composition and nutritional value of raw Chickling vetch seed and calculated nutrient profile of rations were shown in the tables 1, 2, and 3. Performance of broiler fed graded levels of Chickling vetch (raw or processed) in diets are presented in Table 4.

RESULTS AND DISCUSSION

The average of dry matter was 93.2 percent, gross energy was 4150 Kcal/Kg, crude protein, crude fat, crude fiber, ash, ca and p were 26.9, 1.35, 6, 4.5, 0.11 and 0.48 percent, respectively. The average of feed consumption per day by broiler chicks fed on rations with replacement levels of chickling vetch raw or processed 0, 10, 20 and 30% were 36.3, 40.2, 39.5 and 37.8 grams per bird for starter priods, respectively but there were no significant differences ($P > 0.05$). While the average of feed consumption per day by broiler chicks fed on rations with replacement levels of chickling vetch raw or processed 0, 10, 20 and 30% were 125.1, 120.5, 121.6 and 124.2 grams per bird for grower priods, respectively. The highest feed consumption per day was 125.1 grams on ration (0% chickling vetch seed). While the lowest feed consumption

Table 1: Composition and analysis of experimental diets

Ingredients (kg/100 kg)	Starter diets				Grower diets			
	Replacement levels of Chickling vetch raw or processed (%)				Replacement levels of Chickling vetch raw or processed (%)			
	0	10	20	30	0	10	20	30
Corn	56.99	49.6	45.3	39.9	63.79	55.06	52.25	46.03
Chickling vetch	0	10	20	30	0	10	20	30
Soybean meal[1]	35.73	33	25.6	19.9	27.03	26.24	16.66	12.24
Fish meal[2]	3	1.66	3.11	3.56	2.19	3.89	3.99	5
Sun flower oil	1.67	3	3.5	4.3	4.5	2	4.75	4.41
Oyester shell	1.1	1.09	1	0.95	1.07	1.09	0.96	0.93
Dicalcium phosphate[3]	0.95	1.06	0.86	0.77	0.86	1.08	0.76	0.75
Salt	0.3	0.3	0.3	0.3	0.27	0.3	0.27	0.25
D L – Methionine	0.15	0.20	0.22	0.26	0.18	0.23	0.25	0.29
Vitamin-mineral premix[4]	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10
Calculated analysis :								
AMEn (kcal/kg)	2981	2981	2981	2981	3106	3106	3106	3106
CP(%)	22.75	22.75	22.75	22.75	20.5	20.5	20.5	20.5
Linoleic acids (%)	1.91	1.91	1.91	1.91	2.65	2.65	2.65	2.65
Met (%)	0.41	0.41	0.41	0.41	0.4	0.4	0.4	0.4
Lys (%)	1.33	1.33	1.42	1.46	1.17	1.2	1.25	1.29
Ca (%)	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85
$P_{available}$ (%)	0.42	0.42	0.42	0.42	0.42	0.42	0.42	0.42

1-44% Cp. 2- 60% Cp. 3- 22% Ca ; 18.7% P. 4-provided per kg of diet : vitamin A , 9 , 000 Iu ; vitamin D3 , 1,500 Iu ; vitamin E , 10 Iu; vitamin K , 5 mg ; vitamin B12 , 0.007 mg ; thiamin , 0.4 mg ; riboflavin , 6 mg ; folic acid , 1 mg ; biotin , 0.15 mg ; pantathenic acid , 12 mg ; niacin , 35 mg ; pyridoxine , 4 mg ; choline , 1 , 000 mg ; Mn , 60 mg ; Cu , 5 mg ; Zn , 50 mg ; Se , 1 mg ; I , 0.35 mg ; ethoxyquin , 1,25 mg .

Table 2: Chemical composition and nutritional value of raw Chickling vetch seed

Nutrient	% DM
Gross energy (Kcal/Kg)	4150
Crude protein	26.9
Crude fibre	6
Ether extract	1.35
Ash	4.5
Neutral detergent fibre	33.7
Acid detergent fibre	6.1
Calcium	0.11
Total phosphorus	0.48
Total phenolic compounds+ tannin	0.24
Total phenolic compounds- tannin	0.08
Total tannin content	0.16
Condensed tannin	0.03
OADP*	0.26

*N-Oxalyl α-β-Diamino Propionic acid (ODAP)

Table 3: Amino acid composition

Amino acids	Chickling vetch (26.9% CP) %DM	g/100g protein	Chemical score (%)	Soybean meal (44% CP) NRC94
Lysine	1.21	4.49	61.93	2.69
Methionine	0.21	0.78	25.83	0.62
Cystine	0.32	1.19	55.09	0.66
Threonine	0.80	2.97	67.35	1.72
Tryptophan	0.11	0.41	30.83	0.74
Arginine	1.63	6.06	92.94	3.14
Isoleucine	0.78	2.89	54.22	1.96
Leucine	1.23	4.57	52.89	3.39
Phenylalanine	1.11	4.13	76.34	2.16
Tyrosine	1.01	3.75	94.45	1.91
Glycine	0.90	3.34	97.34	1.90
Serine	1.28	4.76	61.66	2.29
Valine	0.94	3.49	51.17	2.07

Table 4: Performance of broiler fed graded levels of Chickling vetch (raw or processed) in diets

Periods	Parameters	Replacement levels of Chickling vetch (%) in diet				Processing effect	
		0	10	20	30	Raw	Autoclaving
Starter	Final Body Weight(g)	304^{ab}	319^{a}	316^{a}	292^{b}	301^{b}	314^{a}
	Average Daily Gain (g)	26.9^{b}	29.1^{a}	27.8^{ab}	25.1^{c}	26.2^{b}	28.3^{a}
	Feed intake (g/day)	36.3	40.2	39.5	37.8	37.9	38.9
	Feed conversion ratio	1.35^{b}	1.38^{b}	1.42^{b}	1.52^{a}	1.46^{a}	1.38^{b}
Grower	Final Body Weight(g)	1997^{a}	1936^{b}	2019^{a}	2039^{a}	1988	2007
	Average Daily Gain (g)	60.4^{b}	57.8^{c}	60.8^{ab}	62.4^{a}	60.2	60.5
	Feed intake (g/day)	125.1^{a}	120.5^{b}	121.6^{b}	124.2^{a}	124^{a}	121.7^{b}
	Feed conversion ratio	2.07^{a}	2.09^{a}	2^{b}	1.99^{b}	2.06^{a}	2.02^{b}

per day was (120.5-121.6) grams on ration (10 and 20 % chickling vetch seed). There was non-significant ($p>0.05$) difference among different experimental groups as far as autoclave processing was concerned for starter priods. However highly significant ($p<0.05$) differences were observed in feed consumption per day for grower priods among the experimental groups on the basis of different levels of chickling vetch seed. The result showed that processing had favorable effects on feed (124g Feed intake vs 121.7g Feed intake). It was observed that the feed consumption per day by chicks was decreased when the level of raw chickling vetch seed was increased as compared to control groups. These results are in accordance with the findings of Rotter et al. (1991). Castell et al. (1994), who reported that feed intake in broiler and swine were significantly reduced as chickling vetch seed content increased.

The average daily gain (ADG) of broiler chicks fed on rations with replacement levels of chickling vetch raw or processed 0, 10, 20 and 30% were 26.9, 29.1, 27.8 and 25.1grams per bird for starter priods, respectively. So, the average daily gain (ADG) of Broiler chicks fed on rations with replacement levels of chickling vetch raw or processed 0, 10, 20 and 30% were 60.4, 57.8, 60.8 and 62.41grams per bird for grower priods. There was significant ($p<0.05$) difference among different experimental groups in both periods for ADG. The highest ADG was 62.4 grams on ration (30% chickling vetch both raw and autoclaved seeds). While the lowest ADG was 57.8 grams on ration (10% chickling vetch both raw and autoclaved seeds). There was non-significant ($p>0.05$) difference among different experimental groups as far as autoclave processing was concerned. The results of this study indicated that the birds consuming lower level of chickling

vetch gained more weight than those consuming higher levels of chickling vetch. The results are in accordance with the findings of Archana Sharma et al. (2003), Castell et al. (1994), hanbury et al. (2000), they all reported significant decrease in ADG of broilers consuming higher levels of chickling vetch. Neurotoxin and ANFs such as trypsin inhibitors, total phenolic compounds, tannin and N-Oxalyl α-β-Diamino Propionic acid (ODAP), may be responsible for the growth retardation in the chicks fed on different levels of chickling vetch (table 2).

The average feed conversation ratio (FCR) values for broiler chicks fed on rations with replacement levels of chickling vetch raw or processed 0, 10, 20 and 30% were 1.35, 1.38, 1.42 and 1.52 per bird for starter priods, respectively. The overall most efficient feed utilization (FCR) was related to experimental groups content 0,10 and % chickling vetch seed). While least efficient feed utilization (FCR) was 1.52 by the chicks fed on ration 30% raw chickling vetch ($p<0.05$). so,there was significant difference in FCR among different experimental groups as far as autoclave processing was concerned ($p<0.05$). The results of the present study are in agreement with the findings of Rotter et al (1990); Archana Sharma et al (2003); who reported that as the level of chickling vetch increased FCR also increased. This difference could be due to the poor digestibility and amino acid chemical score of the increased chickling vetch concentration in the diet, especially essential amino acids as is shown in table 2. The amino acid that shows the lowest proportion is called the limiting amino acid, and the ratio obtained is this score.

This difference for studied parameters could be due to the increased raw chickling vetch concentration in the diet and may be the effects of ANFs and Neurotoxin responsible. The overall lowest value for studied parameters may be due to the processing methods heat treatment with autoclaving the present investigation that appeared to be very advantageous in removing some of the ANFs or Neurotoxin compounds. The results of the present study are in accordance with the findings of Binyam et al. (1995), Girma et al. (1998), they all reported significant decrease in ANFs activity up 91% by processing method of heat treatment (autoclaving).

CONCLUSION

Because of the presence of anti- nutritional factors (ANFs) such as trypsin inhibitors, tannins and some neurotoxin compounds, it was attempted to study different parameters of biological significance. ANFs activities contents were greatness in raw seeds of chickling vetch and lowest after autoclaving.

The biological studies involving different levels (10, 20 and 30%) of chickling vetch, isonitrogenus diet was fed to each group of chicks' ad-libitum. It was concluded that both raw and autoclaved chickling vetch seeds are suitable alternative up 30% of soybean meal and corn seed in broiler nutrition without any adverse effect.

The effect of ANFs cannot be separated from each other and amount of presence of β-3-(-N-Oxalyl)-L-2, 3-Diamino Propionic acid (β-ODAP) or β-N-Oxalyl amino- L-alanine (BOAA) (were not measured). However, it can be concluded that the various ANFs have probably contributed to performance of chicks fed with raw chickling vetch more than levels used this condition experiment.

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