African Journal of Agricultural Research Vol. 3 (5), pp. 379-383, May, 2008
Available online at http://www.academicjournals.org/AJAR
ISSN 1991- 637X © 2008 Academic Journals

Full Length Research Paper

Effect of dietary supplementation of fermented fish silage on egg production in Japanese quail (*Coturnix coromandelica*)

A. A. Zynudheen[1]*, R. Anandan[2] and K. G. Ramachandran Nair[1]

[1]Fish Processing Division, Central Institute of Fisheries Technology, Matsyapuri (PO), Cochin-682 029, India.
[2]Biochemistry and Nutrition Division, Central Institute of Fisheries Technology, Matsyapuri (PO), Cochin-682 029, India.

Accepted 2 May, 2008

The effect of dietary supplementation of fermented fish silage on egg production in Japanese quail was investigated. Body weight gain, egg production and egg quality parameters (shape index, albumen index, yolk index, shell thickness and Hauge unit) were determined. There was no significant difference observed in the body weight gain in fermented fish silage supplemented birds as compared to that of dried fish waste and unsalted dried fish supplemented groups of birds. The total egg production and egg Internal Quality Unit (Haugh unit) of fermented fish silage fed birds was significantly higher compared to the other groups of birds. The results of the study indicate that incorporation of fermented fish waste silage in the poultry feed formulation can increase the egg production in Japanese quails.

Key word: Fermented silage, surimi, Japanese quail, egg production, egg quality, fish waste.

INTRODUCTION

Silage production is considered as one of the best ways of preserving agro and animal waste. Ensilaging is an important method for utilizing trash fish, by catch and processing wastes which provide high quality protein for livestock such as poultry, pigs, calves and other species such as mink. By-products from fishing industry have great potential to be used as protein supplement in feeds (Rose et al., 2003). The conversion of fish waste to silage has the advantage of being an inexpensive supplement for animal feed, while reducing waste and environmental contamination. Fermented fish silage is prepared by mixing fish/fish waste with a fermentable sugar source and a starter culture of lactic acid bacteria (Raghunath and Gopakumar, 2002).

Surimi is a wet frozen concentrate of myofibrillar proteins of fish muscle (Rajalekshmi, 2004). It is deboned, washed and stabilized fish mince. The overall surimi manufacturing process is reported to be quite inefficient resulting in 12 - 20% yield from round fish to finished product. The bulk of the remaining solid waste (65 - 70%) ends up as fishmeal (French and Pederson, 1990). Muraleedharan et al. (1996) and Sankar (2000) studied the filleting yield and wastage from different marine fish species and Indian major carps, respectively. The surimi production in India is increasing every year; the export of surimi and fish fillet from the country for the year 2004 is 31509.5 and 421 tons, respectively (Anon, 2004). In the filleting machine, 67.1% waste is generated and additional 1% waste is resulted during deboning. If the unused sarcoplasmic protein which comes to 7.5% is included, 75.5% by weight of round fish becomes waste which can be used for silage preparation. Hence, during the processing of the above quantity of surimi about 94, 528 metric tons of waste is being generated which can be effectively used for the production of fish silage.

The production of fermented silage from the fish processing waste is not only an effective way to convert the waste into beneficial products but also minimize the environmental problems arising from the waste. In the present study, an attempt has been done to assess the effect of dietary supplementation of fermented fish silage

*Corresponding author. E-mail: zynu@rediffmail.com. Tel: +91-484-2666845. Fax: +91-484-2668212

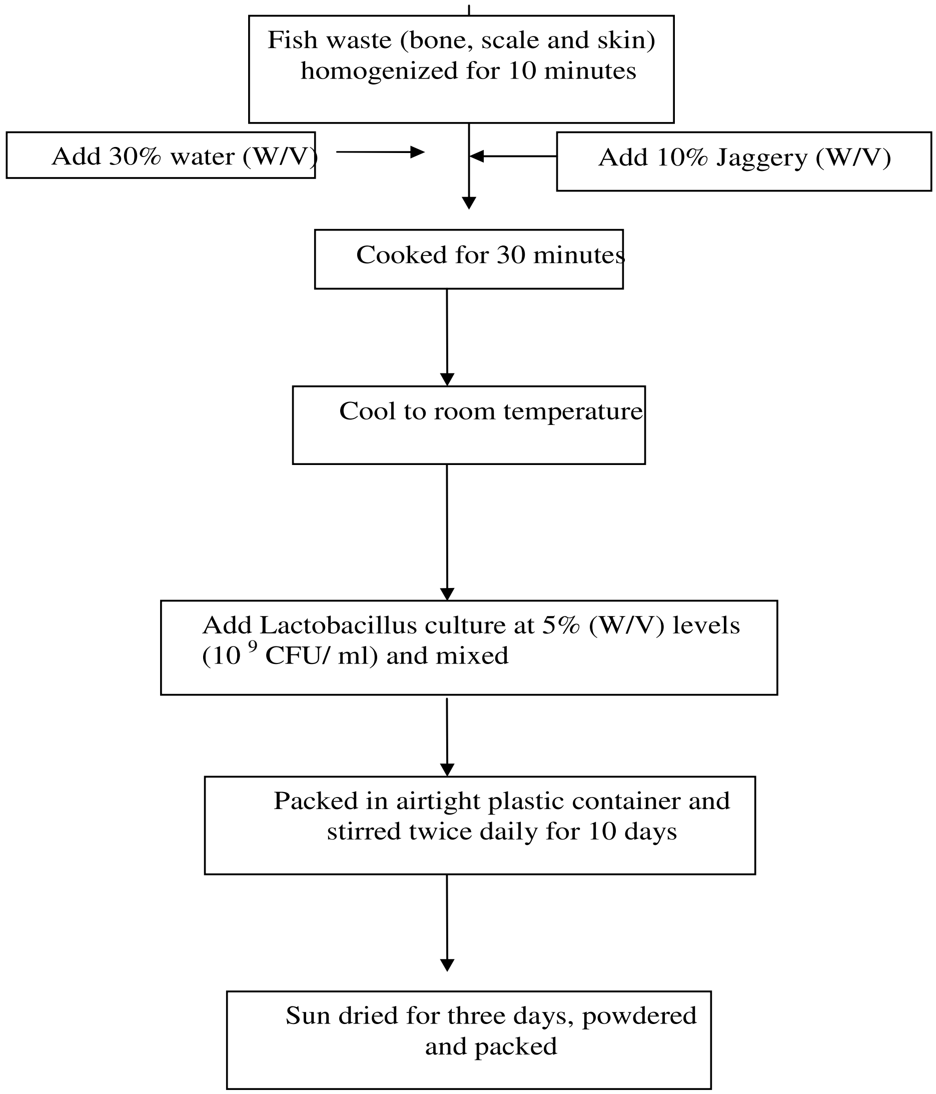

Figure 1. Schematic diagram in the preparation of fermented silage from surimi waste of *N. japonicus*.

silage prepared from surimi waste on egg production in Japanese quails.

Materials and Methods

The present study was conducted during March 2006 at Department of Poultry Science, Kerala Agricultural University, Mannuthy, Kerala, India. The experiment was carried out based on the guidelines of Committee for the Purpose of Control and Supervision of Experiments on Animals (CPCSEA), New Delhi, India.

Japanese quails (Coturnix coromandelica)

The quails (6 weeks old) were procured from Veterinary College, Kerala Agricultural University, Mannuthy, Kerala, India and acclimatized with the experimental feed for one week before the start of the study.

Chemicals and culture

Amino acid standards and tryptophan were obtained from M/s. Sigma Chemical Company, St. Louis. MO, USA. All the other chemicals used were of analytical grade. *Lactobacillus plantarum* culture was procured from MTCC 1425 IMTECH Chandigargh, revived and repeatedly sub cultured in MRS broth and used. Jaggery was obtained from local market.

Preparation of fermented fish silage

The surimi processing waste obtained from *Nemipterus japonicus* was homogenized for 10 min and cooked for 30 min with 10% Molasses (w/w). It was cooled and then inoculated with *L. plantarum* culture at 5% (w/v) level containing 10^9 CFU/ml. The whole mass was mixed thoroughly, transferred into plastic buckets and covered tightly with lid and allowed to ferment for a period of 10 days with occasional stirring. (Figure 1)

Table 1. Composition of feeds used for feeding Japanese quail.

	Ingredients (%)	Group 1	Group 2	Group 3
1	Yellow maize	50.0	50.0	42.0
2	Gingili oil cake	5.0	2.0	5.0
3	Soy bean	24.0	27.0	23.0
4	Unsalted dried fish	8.0	-	-
5	Fermented fish silage	-	10.0	
6	Dried fish waste	-	-	8.5
7	Wheat bran	-	-	4.0
8	Rice polish	6.0	4.0	10.5
9	Shell grit	5.0	5.0	5.0
10	Vitamin mineral mixture	1.75	1.75	1.75
11	Salt	0.25	0.25	0.25

Experimental protocol

Feed

Feed was prepared by mixing the ingredients to produce a total 2700 Kcal/Kg weight of feed. The supplemented silage and dried fish waste were adjusted by nitrogen content in dry weight basis so as to get equal quantity of protein nitrogen in all the groups. The feed components (Table 1) were powdered, mixed properly and provided to different groups as given below:

- Group 1. Control ration with 10% unsalted dried fish
- Group 2. Control ration in which unsalted dried fish was replaced by fermented fish waste silage in terms of crude protein content.
- Group 3. Control ration in which unsalted dried fish was replaced by dried fish waste in terms of crude protein content.

The birds were divided at random into three groups consisted of 48 quails in each group. The experimental birds were maintained under hygienic condition and provided with food and water *ad libitum*.

The experiment was carried out in triplicates for a period of 28 days. Eggs were collected daily and quality determination was conducted once a week (one week interval of time). Soft-shelled, cracked and small eggs were not used. The egg weight was noted one by one and stored at 13°C. The egg shape index was measured using an electronic digital caliper. After measuring the diameter of the eggs, these were broken under well-arranged glass and five minutes later, long and short diameter and height of both albumen and yolk were measured with electronic caliper. Separated yolks were weighed and recorded. Shells of broken eggs were washed with water to separate the albumen and air-dried. The shape index, albumen index, yolk index, shell thickness and Hauge unit of eggs collected were determined using the method of Kemal et al. (2003).

Shape index = short border/long border x 100; Albumen index = albumen height /albumen diameter x 100; Yolk index = yolk height /(long diameter of yolk + short diameter of yolk/2)x 100; Shell thickness = (sharp point thickness + equator thickness + stubby thickness)/3; Haugh Unit = 100 x log (Albumen weight + 7.57 - 1.7 x egg weight x 0.37).

Determination of proximate and amino acid composition analyses

The moisture, crude protein, crude fat and ash content of fish silages used were determined as per AOAC (2000). Total amino acid composition was estimated by the method of Ishida et al (1981) using Shimadzu 10AS Amino Acid Analyzer. Tryptophan content was determined spectrophotometrically using the method of Sastry and Tummuru (1985).

Statistical analysis

Results are expressed as mean ± SD and Student *t*-test was used to determine the statistical significance.

RESULTS AND DISCUSSION

The proximate composition of the dried fish waste and fermented fish waste silage is presented in Table 2. There is no significant variation observed in the composition except that of the protein content. The reduction noticed in protein content in fermented fish silage might be due to the volatile nitrogenous compounds lost during the preparation of silage. Table 3 shows the amino acid composition of the dried fish waste and fermented fish waste silage. Significant variation in the amino acid composition was observed between dried fish waste and fermented fish silage. The percentage of aspartate, threonine, tyrosine and valine was significantly higher in fermented fish silage. Reduction noted in other amino acids might be due to the utilization of amino acids by *Lactobacillus* during the fermentation process.

Changes in the body weight, egg production, egg shape index, egg albumen index, egg yolk index and egg Hauge unit of experimental groups of quails are shown in Table 4. Results revealed that there were no significant variations observed in the body weight gain among the experimental groups of birds. These indicate that there were no adverse effect of dietary supplementation of dried fish waste, unsalted dried fish and fermented fish silage in quails. However, among the groups dried fish waste fed animals showed better body weight index.

The egg production in Group II birds fed with ferment-

Table 2. Proximate composition of surimi waste silage and fish waste (%).

	Fermented surimi waste silage	Dried surimi waste
Moisture	8.55 ± 0.52	7.22 ± 0.41
Crude Protein	51.04 ± 1.25	53.49 ± 1.72
Crude fat	4.98 ± 0.42	5.13 ± 0.37
Ash	33.32 ± 0.51	35.68 ± 0.43

Table 3. Amino acid composition of dried fish waste and fermented surimi waste silage.

	Dried fish waste	Fermented fish waste silage
Taurine	1.41	0.63
Aspartic acid	8.65	9.76
Threonine	3.4	4.39
Serine	6.06	5.81
Glutamic acid	10.37	9.96
Proline	1.34	1.43
Glycine	30.35	29.07
Alanine	14.05	13.14
Cysteine	-	-
Valine	3.22	4.25
Methionine	3.14	2.88
Isoleucine	2.68	0.5
Leucine	4.79	3.35
Tyrosine	1.54	5.65
Histidine	3.14	3.51
Lysine	1.09	1.32
Arginine	1.74	2.17

Table 4. Changes in the body weight, egg production, egg shape index, egg albumen index, egg yolk index and egg Hague unit of experimental groups of quails.

	Group 1	Group 2	Group 3
Body weight at 6 week	187.36	188.00	193.04
Egg production	30.85	45.75	36.45
Mean egg weight	11.01	10.96	11.67
Mean IQU (Hague unit)	69.71	75.44	70.91
Mean yolk index	0.471	0.471	0.472
Mean albumen index	0.138	0.137	0.127
Shape index	75.74	78.81	84.28
Mean shell thickness	0.194	0.192	0.181

ed fish waste silage was significantly the highest compared to Group I unsalted fish and Group III dried fish waste fed birds. Since the birds under study were meant mainly for egg laying purpose, the enhanced egg production indicates the superiority of the fermented silage over the other groups. However, there was no significant variation noted in the egg weight among the different groups. Similar observations were reported by Vali et al. (2006) while comparing the egg weight of two different strains of quails.

In the present study, the eggs of Group II fermented silage fed birds exhibited maximum of the major egg quality index with an IQU of 75.44. This is in corroboration with an earlier reported study (Ihekoronye and

Ngoddy, 1985) which showed that high quality egg generally had IQU of 70and above. Studies conducted by Kirikçi et al. (2003) also showed similar results (75.5%) in Fulani-ecotype chicken. Other egg quality parameters like albumen index, shape index ad shell thickness did not show much significant variation among the groups. The yolk index also suggested that eggs from the fermented silage fed quails were highly desirable when compared with the other two groups. IQU and yolk index are the best indicators of internal egg quality (Kirikci et al., 2007).

The results of the present study indicate that fermented fish silage prepared from waste of surimi production can be used as an imperative ingredient in the dietary feed formulation of Japanese quails to enhance good quality egg production. Since higher egg production with superior quality is an essential and preferable criterion in poul-try, the incorporation of fermented fish silage in dietary feed formulation in poultry may be used as an effective, suitable and cheaper protein source.

ACKNOWLEDGEMENT

The financial aid from the Indian Council of Agricultural Research for A. A. Zynudheen is gratefully acknowledged. The authors are thankful to Dr. Amritha Viswanathan, Professor, Veterinary College, Kerala Agricultural University, Mannuthy, Kerala, India for providing all necessary facilities in the conduct of the experiment.

REFERENCES

Anon (2004). The Marine Products Export Development Authority, Statistics of Marine Products Exports 2004, Kochi, India.

AOAC (2000). Official methods of analysis. Association of official analytical chemists. 12th Ed. AOAC International. Washington. DC.

French JS, Pederson LD (1990). Properties and Stability of Surimi Combined with Process Water Protein Concentrate. Proc. IIF-IIR Commission, Aberdeen (UK), p. 97.

Ihekoronye AT, Ngoddy PO (1985) Integrated food science technology for the tropics. Macmillan Press Ltd. London. pp.55-62.

Ishada Y, Fugita T, Asai K (1981). New detection and separation method for amino acid by high performance liquid chromatography. J Chromato., 204: 143-148.

Kirikçi K, Günlü A, Çetin O, Garip M (2003). Some quality characteristics of pheasant (*P. colchicus*) eggs. Food Agric. Environ. 1(3&4): 226-228.

Kirikci K, Gunlu A, Cetin O, Garip M (2007). Effect of hen weight on egg production and some egg quality characteristics in the partridge (*Alectoris graeca*). Poult Sci.; 86(7): 1380-1383.

McDonald P, Handerson AR, Herson SJE (1991). The Biochemistry of Silage. Chalcombe Publications, Marlow, Buckinghamshire, UK. p. 340.

Muraleedharan V, Antony KP, Perigree PA, Gopakumar K (1996). Utilisation of Unconventional Fish Resources for Surimi Preparation. In: Proceedings of the Second Workshop on Scientific Results of FORV *Sagar sampada* (Pillai VK, Abidi SAH, Ravindran V, Balachandran KK, Agadi VV *Eds*) Department of Ocean Development, New Delhi, pp. 539-543.

Raghunath MR, Gopakumar K (2002). Trends in Production and Utilisation of Fish Silage. J. Food Sci. Technol. 39 (2): 103-110.

Rajalekshmi M (2004). Protein stabilization and gel enhancing effects of chitosan on the myofibrillar protein concentrate from threadfin bream (*Nemipterus japonicus*). Ph. D thesis submitted to Central Institute of Fisheries Education , Mumbai.

Rose MV, Elisabete MMV, Dalton JC (2003). Amino Acid Composition of Processed Fish Silage Using Different Raw Materials. Anim. Feed Sci. Technol. 105: 199-204.

Sankar TV (2000). Biochemical and Storage Characteristics of Myofibrillar Protein Concentrate (Surimi) From Indian Major Carp. Ph.D Thesis, School of Industrial Fisheries, Cochin University of Science and Technology.

Sastry CSP, Tammuru MK (1985). Spectrophotometric determination of tryphtophan in protein. J. Food. Sci. Technol. 22. 146-147.

Vali N, Edriss MA, Moshtaghi H (2006). Comparison of Egg Weight Between Two Quail Strains. Int J. Poult. Sci. 5(4): 398-400.