GAU Res. J., 34 (2) : 143-147 (2009)

# Studies on shelf life of formulated shrimp feed

**M. K. Bhalala and K. L. Jetani**

Fisheries Research Station
Junagadh Agricultural University, Okha Port – 361 350 (Gujarat)

**Abstract**

**Three formulated shrimp feed namely, Feed type – I (30 % protein level), Feed type-II (40 % protein level) and Feed type-III (45 % protein level), were prepared and compared for their physical properties, proximate composition and microbial contamination. The result obtained suggest that increase in the moisture content in all the feed directly or indirectly affect nutritive value during storage period and all the feed showed decreasing trend of all nutrient value. Feed with high protein value was found to be more susceptible then with low protein content.**

**Keywords :** Shrimp feed, fishmeal, shelf life

## Introduction

In aquaculture, dairy, poultry, and piggery, the practice is to prepare the feed in bulk for its utilization over a long period (1). Feed so prepared is found to suffer from quality deterioration in due course of time, thereby often becoming unfit for animal consumption. The reason for deterioration of feed quality had been studied by several workers in their field. The quality of feed undergoes changes with the passage of time due to reasons such as storage period, available moisture, content of feed, way of processing, exposure to atmospheric temperature and light. These factors are responsible for promoting the process of degradation of its nutritional quality, microbial contamination and thereby making it unfit for animal consumption

Fungus is reported to grow at a relative humidity above 70% (2). Due to this reason during rainy season fungi grow more than the other season. The moisture content at around 15% is convenient / favourable for the growth of normal fungi group. However some Mycotoxins producing fungi even grow in 9-11% moisture level. The fungal and bacterial growth cause weight loss, increase in temperature and moisture, discoloration and some of them produce Mycotoxins; which are harmful to animal and retard the growth (3).

The present study is aimed to investigate the change in nutritional value, physical properties, microbial contamination and acceptability of the lab experimental feed.

## Material and methods

Experiment was carried out during the year of 1997 - 2000 on formulated shrimp feed. Various feed ingredients like, fish meal, ground nut oil cake, fish protein concentrate, rice bran, sun flower oil cake, wheat flour, vitamins and minerals were used for the preparation of the pelleted feed. The ingredients were procured from local market except F.P.C. which was prepared in lab. The ingredients proportion were used according to "Pearson Squares" method. The types of pelleted feed were formulated namely, feed Type-I – 30% protein level, Feed type-II 40% protein level and Feed type-III 45% protein level, with varying proportions of the ingredients, sun flower oil cake and ground nut oil cake were finely powdered and all other ingredients were then individually sieved through ISI standard mark mesh size 250 micrometer to get particles of uniform size.

Required quantities of various ingredients were then mixed except binder. Wheat flour was used as a binder mixed with water in proportion 1:07 (dry weight of total ingredients to water by weight) and gelatinized by giving gentle heat. The gelatinized paste of wheat flour was mixed with the premixed ingredients. The dough prepared by hand kneading and dough so obtained was steamed in pressure cooker at 105°C for 30 minutes. The cooked dough was then allowed to cool to room temperature by spreading in aluminum tray. Minerals and vitamins were added into dough by through mixing. Finally the dough was extruded through the manual pelletizer having 1.8 mm pores. The pellets were dried in hot air over at 60°C for 5-6 hrs.

The dried feeds were packed in polythene bag separately as per normal procedure. The feed were cooled at ambient temperature before packing of bags. Then they were kept at room temperature in a cupboard and used in this experiment after its storage for 1 month to 12 month.

The observation of physical properties like crispness, odour, colour resistance to crumbling etc., of all the feed were taken initially and after every month. All the feeds were tested for the nutritive value and microbial contamination every month as per APHA (4) . AOAC (5) and Ranganna (6) to observe the effect of storage.

## Results and discussion

Twelve months of storage showed that the physical properties like crispness, odour, colour, resistance to crumbling, sinking capacity, visual water stability of all the feeds were found to be similar to the initial observation.

However observation after six months of storage showed inferior physical property in Feed type-I and Feed type-II where as in Feed type-III after four month. Subsequently after six months storage period observations showed that these properties had declined in all feed. Feed type-I and Feed type-II up to six months of storage showed good acceptance by mullet fish (*Mugil spp.*), while after six months acceptance of feeds was poor as compared to initial results, while Feed type-III showed good acceptance only up to four months (Table 1A, 1B, and 1C)

The observation on nutritive value; crude protein, crude fat, crude ash, crude fibre have shown decreasing trend in all type of feed. It is worth to pin point that first four months did not show much decrease in above value compared to those of later period. Correlation of protein, fat, carbohydrate, moisture content with storage period were tested and were found significant.

The microbial contamination, TPC and fungi increased gradually. While staphylococcus sp. did not change much during the storage period. Fungi, insects and their spores were observed in all feed after 10 months of storage.

It was observed that Feed type-I and Feed type—II had prolonged shelf life (up to six month) while Feed type—III had four months only. It was observed that moisture content gradually increased in all the feed (Table 2A, 2B and 2C). The high protein feed has been reported to be more susceptible to rancidity. All the feed followed the same trend in respect of moisture content, decreasing protein and fat level after 4-6 month. Nitrogen free extract i.e. carbohydrate is mainly in the form of starch (in wheat flour, rice bran etc) in feed stuff, under the reaction of alpha and beta amylase, starch decomposes into dextrin and rafinose because in humidity – above 70-80% during storage the amylase action increase moisture content in feed. One more observation was that storage period coincided with atmosphere, when atmospheric humidity is high especially in coastal zone and this could be one of the reasons for increased in moisture content. Due to the action of amylase, sugar decomposes into $CO_2$ and $H_2O$ and dry matter decreases protein digestibility. This happened due to oxidation of protein. The moisture content increased by the carbohydrate intensified this reaction.

So the variation noted in the value of ash and crude fibre is mainly due to the moisture content of the feed associated with change during the period of the storage (Table 2A, 2B and 2C).

On the bases of the observation fat broke down into free fatty acid; made the feed more prone to the development of rancidity. This breakdown is caused by the damage resulting from bacterial infection and fungal growth. Fish meal, GNOC etc., are particularly vulnerable to this type of chemical change as seen in all feed types. On the base of observation (Table -2A, 2B and 2C) carbohydrate increased gradually that stimulated the growth of fungi resulting in breakdown of remaining starch and carbohydrates into moisture, acetic acid and alcohol which in turn stimulated the protein oxidation; due to this reason the protein content gradually decreased in all feed types. The fungi almost present in GNOC and sun flower oil cake beside this its spores were present outside and inside the pack and surface of product during the process. The experiment of shelf life revealed storage of feeds to be satisfactory up to six months for < 40% protein level and four months for > 40% protein level; i.e. higher the protein level shorter the life span and vice versa.

**ACKNOWLEDGEMENT**

The authors are highly thankful to Dr. B. K. Kikani, Vice - Chancellor and Dr. D. B. Kuchadia, Director of Research and Dean P. G. Studies, Junagadh Agricultural University, Junagadh, for providing necessary facilities and encouragement in the present experiment. Thanks are also due to Dr. Dhruj, Assistant Director of Research, Junagadh Agricultural University, Junagadh for his constant interest and the encouragement for quality research in fisheries.

**Table 1. The Effect of Storage on Physical Properties of Formulated Shrimp Feed**

**Table 1A** Feed Type – I, (30% Protein Level)

| Sr. No. | Physical parameter | Fresh stock | After 2 month | After 4 month | After 6 month | After 8 month | After 10 month | After 12 month |
|---|---|---|---|---|---|---|---|---|
| 1. | *Crispness* | Crisp | Crisp | Crisp | Crisp | Less | No | No |
| 2. | *Odour* | Fishy | Fishy | Fishy | Fishy | Fishy | Rancid | Rancid |
| 3. | *Colour* | Brown | Brown | Brown | Brown | Brown | Dark | Dark |
| 4. | *Resistance to crumbling* | Resistant | Resistant | Resistant | Resistant | Less | Less | Too less |
| 5. | *Sinking capacity* | Sink | Sink | Sink | Sink | Less | Less | Too less |
| 6. | *Visual water stability* | Stable | Stable | Stable | Stable | Less | Less | Less |
| 7. | *Acceptance* | Good | Good | Good | Good | Poor | Poor | Poor |

**Table 1B** Feed Type –II, (40% Protein Level)

| Sr. No. | Physical parameter | Fresh stock | After 2 month | After 4 month | After 6 month | After 8 month | After 10 month | After 12 month |
|---|---|---|---|---|---|---|---|---|
| 1. | *Crispness* | Crisp | Crisp | Crisp | Crisp | Less | No | No |
| 2. | *Odour* | Fishy | Fishy | Fishy | Fishy | Rancid | Rancid | Rancid |
| 3. | *Colour* | Brown | Brown | Brown | Brown | Dark | Dark | Dark |
| 4. | *Resistance to crumbling* | Resistant | Resistant | Resistant | Resistant | Less | Less | Too less |
| 5. | *Sinking capacity* | Sink | Sink | Sink | Sink | Less | Less | Too less |
| 6. | *Visual water stability* | Stable | Stable | Stable | Stable | Less | Less | Less |
| 7. | *Acceptance* | Good | Good | Good | Good | Poor | Poor | Poor |

**Table 1C** Feed Type –III (45% Protein Level)

| Sr. No. | Physical parameter | Fresh stock | After 2 month | After 4 month | After 6 month | After 8 month | After 10 month | After 12 month |
|---|---|---|---|---|---|---|---|---|
| 1. | *Crispness* | Crisp | Crisp | Crisp | Less | No | No | No |
| 2. | *Odour* | Fishy | Fishy | Fishy | Less | Less | Rancid | Rancid |
| 3. | *Colour* | Brown | Brown | Brown | Dark | Dark | Dark | Dark |
| 4. | *Resistance to crumbling* | Resistant | Resistant | Resistant | Less | Less | Less | Too less |
| 5. | *Sinking capacity* | Sink | Sink | Sink | Less | Less | Less | Too less |
| 6. | *Visual water stability* | Stable | Stable | Stable | Less | Less | Less | Less |
| 7. | *Acceptance* | Good | Good | Good | Poor | Poor | Poor | Too much poor |

**Table 2. The Effect of Storage on Proximate Composition & Microbial Contamination of Experimental Shrimp Feed**

***Table 2A*** Feed Type –I (30% Protein Level)

| Parameters \ Month | May | June | July | Aug | Sept. | Oct. | Nov. | Dec. | Jan. | Feb. | Mar. | Apr. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Crude protein (%) | 32.81 | 31.9 | 30.5 | 28.7 | 27.4 | 26.5 | 25.9 | 25.8 | 22.8 | 21.3 | 20.7 | 20.10 |
| Crude fat (%) | 6.8 | 6.8 | 6.5 | 6.1 | 5.8 | 5.6 | 5.3 | 4.9 | 4.8 | 3.5 | 3.3 | 3.3 |
| Crude ash (%) | 27.30 | 27.30 | 27 | 26.7 | 26.80 | 25.2 | 24.3 | 24.3 | 22.6 | 20.44 | 20.22 | 20.10 |
| Crude fibre (%) | 8.7 | 8.7 | 8.6 | 8.7 | 8.5 | 8.8 | 8.6 | 8.7 | 8.7 | 8.6 | 8.67 | 8.6 |
| Carbohydrate (%) | 14.28 | 14.19 | 15.45 | 16.17 | 17.87 | 17.26 | 19.63 | 19.8 | 23.46 | 27.68 | 29.61 | 27.4 |
| Moisture (%) | 10.11 | 11.11 | 11.95 | 13.63 | 13.63 | 16.64 | 16.27 | 16.5 | 17.64 | 18.48 | 19.5 | 20.5 |
| TPC cfu / gm (in lack) | 0.14 | 0.17 | 0.30 | 0.26 | 0.30 | 0.28 | 0.33 | 0.36 | 0.38 | 0.57 | 0.49 | 0.50 |
| E.coli (no./gm) | Nil | Nil | Nil | Nil | Nil | Nil | Nil | Nil | Nil | Nil | Nil | Nil |
| Staphylococcus spp. (no./gm) | 50 | 40 | 40 | 60 | 50 | 50 | 60 | 40 | 50 | 60 | 50 | 50 |
| Streptococcus spp. (no./gm) | Nil | Nil | Nil | Nil | Nil | Nil | Nil | Nil | Nil | Nil | Nil | Nil |
| Salmonella spp. (neg.) | 25 gm | 25 gm | 25 gm | 25 gm | 25 gm | 25 gm | 25 gm | 25 gm | 25 gm | 25 gm | 25 gm | 25 gm |
| Fungi col./gm | 20 | 25 | 30 | 40 | 60 | 150 | 140 | 150 | 90 | 140 | 140 | 150 |

***Table 2B*** *Feed Type –II (40% Protein Level) (May-1998-Apr.1999)*

| Parameters \ Month | May | June | July | Aug | Sept. | Oct. | Nov. | Dec. | Jan. | Feb. | Mar. | Apr. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Crude protein (%) | 40.03 | 39.78 | 38.34 | 37.6 | 37.1 | 36.2 | 35.2 | 34.8 | 33.4 | 32.8 | 31.12 | 30.5 |
| Crude fat (%) | 9.4 | 8.9 | 8.4 | 7.81 | 7.63 | 6.51 | 5.96 | 5.89 | 5.12 | 4.92 | 4.63 | 4.3 |
| Crude ash (%) | 15.24 | 15.09 | 16.14 | 16.14 | 15.20 | 15.60 | 15.20 | 14.90 | 15.01 | 14.70 | 14.60 | 14.90 |
| Crude fibre (%) | 8.70 | 8.70 | 8.64 | 8.7 | 8.6 | 8.5 | 8.6 | 87.5 | 8.6 | 6.5 | 8.3 | 8.25 |
| Carbohydrate (%) | 15.52 | 15.61 | 15.83 | 16.15 | 16.67 | 18.51 | 18.54 | 18.7 | 19.57 | 19.48 | 20.30 | 20.55 |
| Moisture (%) | 11.11 | 11.92 | 12.65 | 13.60 | 14.8 | 15.68 | 16.5 | 17.21 | 18.3 | 19.6 | 20.30 | 21.5 |
| TPC cfu / gm (in lack) | 0.30 | 0.30 | 0.32 | 0.35 | 0.38 | 0.38 | 0.42 | 0.45 | 0.50 | 0.60 | 0.50 | 0.40 |
| E.coli (no./gm) | Nil | Nil | Nil | Nil | Nil | Nil | Nil | Nil | Nil | Nil | Nil | Nil |
| Staphylococcus spp. (no./gm) | 40 | 30 | 40 | 60 | 40 | 10 | 30 | 50 | 40 | 40 | 50 | 60 |
| Streptococcus spp. (no./gm) | Nil | Nil | Nil | Nil | Nil | Nil | Nil | Nil | Nil | Nil | Nil | Nil |
| Salmonella spp.(neg.) | 25 gm | 25 gm | 25 gm | 25 gm | 25 gm | 25 gm | 25 gm | 25 gm | 25 gm | 25 gm | 25 gm | 25 gm |
| Fungi col./gm | 10 | 20 | 20 | 30 | 35 | 38 | 42 | 50 | 90 | 120 | 150 | 150 |

**Table 2C** Feed Type –III (45% Protein Level)

| Month / Parameters | May | June | July | Aug | Sept. | Oct. | Nov. | Dec. | Jan. | Feb. | Mar. | Apr. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Crude protein (%) | 46.37 | 46.1 | 45.8 | 42.81 | 39.26 | 35.27 | 34.23 | 32.6 | 30.28 | 28.32 | 26.81 | 24.5 |
| Crude fat (%) | 6.82 | 6.89 | 5.83 | 5.4 | 4.2 | 4.82 | 4.23 | 3.91 | 3.72 | 3.91 | 3.86 | 3.33 |
| Crude ash (%) | 20.02 | 20.01 | 20.02 | 20.0 | 20.1 | 20.11 | 20.0 | 19.9 | 19.6 | 19.5 | 19.3 | 19.2 |
| Crude fibre (%) | 8.7 | 8.7 | 8.6 | 8.7 | 8.5 | 8.8 | 8.6 | 8.7 | 8.8 | 8.6 | 8.5 | 8.46 |
| Carbohydrate (%) | 6.98 | 5.8 | 6.55 | 8.99 | 12.44 | 14.7 | 15.14 | 16.39 | 18.1 | 19.37 | 20.63 | 23.21 |
| Moisture (%) | 11.11 | 12.5 | 13.2 | 14.1 | 15.5 | 16.3 | 17.8 | 18.5 | 19.6 | 20.3 | 20.9 | 21.9 |
| TPC cfu / gm (in lack) | 0.16 | 0.22 | 0.30 | 0.24 | 0.29 | 0.23 | 0.33 | 0.36 | 0.28 | 0.57 | 0.49 | 0.50 |
| E.coli (no./gm) | Nil | Nil | Nil | Nil | Nil | Nil | Nil | Nil | Nil | Nil | Nil | Nil |
| Staphylococcus spp. (no./gm) | 50 | 40 | 40 | 50 | 66 | 40 | Nil | 40 | 40 | 50 | 60 | 50 |
| Streptococcus spp. (no./gm) | Nil | Nil | Nil | Nil | Nil | Nil | Nil | Nil | Nil | Nil | Nil | Nil |
| Salmonella spp. (neg.) | 25 gm | 25 gm | 25 gm | 25 gm | 25 gm | 25 gm | 25 gm | 25 gm | 25 gm | 25 gm | 25 gm | 25 gm |
| Fungi col./gm | 25 | 25 | 48 | 20 | 20 | 80 | 90 | 90 | 100 | 120 | 140 | 150 |

## Reference


1. **Akiyama, D. M.** 1991a. Future consideration for the aquaculture feed industry. In:proc. Aqucul. Feed Processing and Nutrition Workshop. Thailand and Indonesia, pp 5-9 American soybean Association, Singapore.

2. **Frazier, W.C. & Westhoff, D.C.,** 1995. In : Food Microbiology. Tata Mc. Graw – Hill publishing Co. Ltd., New Delhi, 4th edition. pp 17-58.

3. **Chia-Kung T.,** 1989. Quality control in formulated feeds – Deteriortion of feed stuff during its storage. In O.Dean M. Akiyma (Ed.) Proceedings of the Peoples Republic of China Aquaculture and feed workshop. pp. 277-287.

4. **A.P.H.A.** 1975. Standard Method for the Examination of water and wastewater, American Health Association, Washington, DC.

5. **A.O.A.C.** 1975. Standard Method for the Examination of water and wastewater, chemists. Pub. A.O.A.C., Washington, DC.

6. **Ranganna, S.** 1977. Manual of analysis of Fruit & Vegetable products. Tata Mc. Graw Hill Publishing Co. Ltd. New Delhi.