

# A CASE STUDY ON THE QUALITY CONTROL OF POULTRY FEED INGREDIENTS IN INDIA

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## ABSTRACT

*A study was conducted to assess the quality control practices of both physical and chemical methods of evaluation adopted by feed mills in India while procuring the feed ingredients for preparing poultry feeds. Based on physical methods of evaluation of different feed ingredients, 6.4 % of lots were found to be inferior quality out of 2606 lots tested. The results indicated that the moisture content of grains procured during the period from October to December months was high whereas it was low from April to July. The protein content of soybean meal varied from 45.5 to 47.5% while its solubility varied from 72.1 to 83.2%. The rejection of raw material consignments was 7.85 %. The major reasons for rejection included high moisture, low protein, high level of sand & silica, adulteration / contamination with foreign materials. The findings of this study emphasises the significance of strict quality control measures to be adopted to ensure feed and food safety.*

**Key Words:** Feed ingredients – feed mills - poultry - quality control.

## INTRODUCTION

The total quantity of feed produced in India is sufficient to meet out the requirement of about 8 million cattle out of the current population of more than 100 million breed-able animals in the country. The total poultry in the country is 851.81 million in 2019, increased by 16.8% over the previous census. The commercial

poultry has increased by 4.5% and the total commercial poultry is 534.74 million (20<sup>th</sup> Livestock Census, 2019). Thus, large gap in the quantity of feed required and produced exist.

Animal feed has a direct influence on the quality and safety of foods of animal origin. Consumers of meat, milk, fish, and eggs expect the industry and retailers to supply safe, high quality products. In India, the quality control is regulated by the statutory body - Bureau of Indian Standards (BIS). Food Safety & Standards Authority

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of India (FSSAI) has decided to bring the subject of animal feeds under the ambit of Food Safety and Standards Act, 2006, and issued a direction that animal feed for food producing animals must comply with the Bureau of Indian Standards (BIS). Feed contributes to 75 - 80% of the total expenses for production of an egg and broiler. The efficiency of feed utilization and performance of poultry are influenced by the physical and chemical composition of feeds (Uppal *et al.*, 2005). Quality of raw materials used for feed manufacturing, particle size, and uniformity greatly affect the production performance and feed conversion efficiency in poultry (Reddy, 2003). Soybean meal is adulterated with guar meal, de-oiled rice bran (DORB), ammonium salts other than urea, etc. The information on common quality control measures adopted by feed mills in India is scanty. Hence, a study was conducted to study the quality control measures adopted by feed mills during the procurement and storage of raw materials to find out remedies and develop strategies to improve the quality of finished feeds.

### **MATERIALS AND METHODS**

Data pertaining to the quality assessment of raw materials at the time of procurement were collected from commercial private feed mills and college feed mill (VC&RI, Namakkal, Tamil Nadu) and analysed. The physical methods of

evaluation of feed ingredients were carried out using all the five senses such as vision, touch, sound, taste. The chemical methods of evaluation were conducted for proximate composition, sand and silica, calcium, phosphorous, soluble protein, free fatty acids and iodine values as per the methods of BIS (IS-7874 – 2002) and AOAC (2002). The solubility of protein was determined using 0.2% KOH solution and the iodine value was estimated as per BIS (548 -1988). The data collected were subjected to statistical analysis (Snedecor and Cochran, 1989).

### **RESULTS AND DISCUSSION**

The data collected from large size private feed mill units in India and the Institute's feed mill for one year (2009-2010) period were analyzed.

#### **Quality control measures during the procurement of feed ingredients**

The results of physical evaluation of feed ingredients at the time of procurement are given Table 1. Based on physical methods of evaluation of different feed ingredients, the results revealed that 6.4 % of lots were found to be inferior in quality out of 2606 lots tested. The variations in quality of feed ingredients could be attributed to agronomic practices, variety, soil & climate and stage of harvesting etc. (Chandrasekaran *et al.*, 2001)

**Table 1. Physical evaluation of raw materials**

Name of the ingredients	Total number of samples analyzed	Percentage of lots rejected
Grains	1850	4.5
De-oiled cakes	320	3.2
Oil Cakes (expeller variety)	106	9.5
Fishmeal & Meat and bone meal / Meat meal	133	6.4
Vegetable oils	120	7.1
Animal fats	49	8.8
Di-calcium phosphate / Calcite / Lime stone powder	28	5.3

The results of various chemical analyses carried out to assess the quality of different feed ingredients are presented in Table 2.

### Maize

The moisture content varied from 8.6 to 16.8% with an average of 10.96% during the period from April to July whereas it was more than average during October to December. Saiful Islam *et al.*, (2015) observed that corn with 14% moisture content can be used in both pellet and mash feeds without any problem and also one can store this corn for about one week without any difficulties. Corn with 15% moisture content can be used only in pellet feed, however, the moisture content of the finished feeds should not be more than 13.5 % as per BIS (2012).

### Bajra

The moisture content of the bajra varied between 8.0 and 13.5% with an average of 10.67%. Moisture content (10.5 %) was less during June through August whereas it was high (13 %) from October to December. The maximum moisture allowed is 14 % as per BIS (IS 4333:2004)

### Soybean meal

The moisture content of soybean meal samples varied between 8.5 and 12.5 % with an average of 10.79%. The protein content varied from 45.5 to 47.5% with an average of 46.6%. The solubility of protein (%) varied from 72.1 to 83.2 with an average of 75.64. The solubility (%) values ranging from 75 to 82 indicated that the soya bean meal was properly processed. Less than 72 % indicated overcooking and more than 85 % indicated undercooking.

**Table 2. Chemical evaluation of feed ingredients**

Category	Feed ingredient / BIS specifications	Parameter	No. of samples	Mean (%)	Range (%)	BIS specifications
<b>Grains</b>	Maize (IS 9629:2004)	Moisture	1480	10.96± 0.9	8.58 - 16.6	13.5% Max.
	Bajra (IS 4333:2004)	Moisture	462	10.67± 0.7	8.0 - 13.5	14.0% Max.
<b>Vegetable protein sources</b>	Soybean meal - 47 % (IS 1374:2007)	Moisture	147	10.79± 0.5	08.50 - 12.5	10% Max.
		Protein		46.60± 1.1	45.5 - 47.5	45% Min.
		Total Ash		7.26± 0.8	7.12 - 7.51	7 % Max.
	Hypro Soybean meal - 50% (IS 1374:2007)	Crude Fiber	312	5.16± 0.4	5.01 - 5.28	4% Max.
		Soluble Protein		79.64± 12.5	72.1 - 83.2	44% Min.
		Moisture		10.10± .7	8.00 - 11.25	10% Max.
<b>Animal Protein sources</b>	Fish meal - 40% (IS 4307:1983)	Protein	65	49.48± 3.3	48.12- 51.51	50% Min.
		Total Ash		6.88± 0.5	6.16 - 7.37	7% Max.
		Soluble Protein		83.21± 7.8	81.63 - 86.66	48 % Max.
		Crude fiber		3.94± 0.2	3.26 - 4.43	4% Max.
		Moisture		14.53± 0.9	11.52 - 17.10	10% Max.
	Dry fish (IS 2884:1964)	Protein	4	41.20± 1.9	38.20 - 43.15	50% Min.
		Total Ash		29.55± 3.2	28.87 - 30.54	17 % Min.
		Calcium		5.11± 0.2	5.01 - 5.20	7.5% Min.
		Phosphorus		1.98± 0.1	1.97 - 1.99	0.5% Min.
		Moisture		6.84± 0.4	5.70 - 7.78	10% Max.
Meat and bone meal - 45% (IS 1942:1968)	Protein	65	47.36± 3.1	46.15 - 48.45	45% Min.	
	Oil		8.56± 1.3	7.20 - 9.86	10 % Max.	
	Total Ash		33.35± 2.6	26.78 - 36.98	20 % Min.	
	Calcium		10.24± 1.0	8.63 - 12.36	10.5% Min.	
	Phosphorus		3.83± 0.3	3.43 - 4.08	5-7% Min.	
<b>Mineral source</b>	DCP (IS 5470-2002)	Moisture	9	2.63± 0.2	1.74 - 4.30	5% Max.
		Sand & Silica		0.79± 0.3	0.30 - 1.23	1 % Max.
		Calcium		24.38± 1.2	21.62 - 25.32	23% Min.
		Phosphorus		16.30± 0.9	16.00 - 17.75	17% Min.
<b>Fats and oils</b>	Tallow (IS 887:1977)	Moisture	42	0.51± 0.1	0.17 - 1.11	1 % Max.
		FFA		1.50± 0.1	1.14 - 2.17	10 % Max.
		Iodine Value		47.09± 2.4	46.38 - 47.74	56 Max.
	RB oil (IS 3448:2014)	Moisture	84	0.31± 0.1	0.18 - 0.38	1% Max.
		FFA		6.32± 0.3	4.71 - 8.05	20% Max.
		Iodine Value		89.91± 2.6	87.97 - 92.7	105 Max.
Soya Oil (IS 4276:2014)	Moisture	27	0.19± 0.1	0.13 - 0.35	0.75% Max.	
	FFA		0.89± 0.2	0.73 - 1.09	6% Max.	
	Iodine Value		127.40± 13	124.89 - 128.49	140 Min.	

All values are expressed on dry matter basis except moisture content

The total ash and crude fibre content were more in 23.5 % of samples than the permitted levels as per BIS specifications. For broilers, soybean meal with high protein (50 % or more) is commonly used by the broiler integrators. The protein content of high protein variety ranged from 48.12 to 51.51 with an average of 49.48 %. The crude fibre content was comparatively low in high protein soybean meal as compared to low protein varieties. The protein and other parameters varied relatively according to the moisture content. Out of 147 number of soybean meal samples tested, 3.4 % were adulterated with NPN compounds such as urea and other NPN substances to boost the crude protein level. Whereas 5.9 % samples were containing low cost materials such as limestone powder / marble chips powder etc., so as to reduce the cost. In such cases, the calcium content of soybean meal needs to be estimated (Chandrasekaran *et al.*, 2001)

### **Fish meal**

Dried fish meal is commonly used in the poultry feed formulations as a source of animal protein. Due to wide variation in the quality of commercially available fish meal in the market and adulteration with the leather meal, dried fish is commonly used by many users instead of readymade fishmeal. The moisture content of fish meal samples ranged from 11.52 to 17.1% with an average of 14.53% which was lower during February & March and higher during the period from September to January. The moisture content of 33.7 % samples were higher than the prescribed limit of 10 % as per the BIS specifications. The protein content varied from 38.2% to 43.15% with

an average of 41.2%. The average values of total ash, calcium and total phosphorous were 32.5, 6.9 and 1.9%, respectively. Wide calcium: phosphorous ratio (above 3:1) is suggestive of adulteration with foreign materials (Ponnusamy *et al.*, 2012).

### **Meat and bone meal**

The mean protein, oil, total ash, calcium and total phosphorous values were 47.36, 8.56, 33.35, 10.24 and 3.8, respectively. Excess oil content (more than 10%) in meat cum bone meal revealed that the separation of fat was not perfect/proper during the process of oil extraction. The calcium and total phosphorus contents were low in 22.5 and 20.9 % of lots tested as compared to the specifications of BIS (2012)

### **Di-calcium phosphate**

The mean moisture and sand & silica contents were 2.63 and 0.79%. The calcium content varied between 21.2% and 25.3 % with an average of 24.3%. The total phosphorous content varied from 16.0 to 17.75% with an average of 16.3%. The calcium content was low in 18.7 %, total phosphorous content was low in 15.9 % whereas sand & silica contents were high in 33.1 % samples as compared to the BIS specifications. This would be attributed to variations in sources (Garg. *et al.*, 2014).

### **Vegetable oils**

The quality of oils was routinely estimated by determining moisture, free fatty acids and iodine value by the feed industry. The free fatty acid levels of rice bran oil varied from 2.83 to 9.5% with an average of 6.3% whereas the average free

fatty acid value of soybean oil was 0.89%. Out of 153 samples of fats and oils tested, 17.5 % samples were of inferior quality. The free fatty acid value of more than 2.0 % in soybean oil is considered as non-acceptable level. Rice bran oil samples containing iodine value from 85 to 95 is preferred. Wide variations in the quality of tallow and rice bran oils were observed as compared to the specifications stipulated by BIS (2012). Similarly, the preferred values for soya oil are between 122 and 130 (Amit, 2020).

### Tallow

The free fatty acid level of tallow varied between 0.8 and 3% with an average

value of 1.5%. Tallow, in general, is used along with vegetable oils in the ratio of 40: 60.

### Rejection of consignments

The rejection (%) of consignment due to poor quality of raw materials is presented in Table 3. A total of 2,432 consignments were received during the study period for producing around 32,700 metric tonnes of feed. The average rejection percent was 7.85. Maximum rejected materials included fish meal, meat, and bone meal and maize. The major reasons for rejection are given in the table (Table 3). Most of the raw materials were checked at the time of procurement and not before use.

**Table 3. Incidence and reasons for consignment rejection in feed mills**

Ingredients	No. of consignments	No. of rejections	Rejection percent	Major reasons for rejection
Maize	1002	96	9.58	High moisture, fungus, contaminants, foreign materials, immature seeds
Bajra	446	35	7.85	High moisture, foreign materials
Soybean meal - 47%	251	14	5.58	High moisture (above 12.0 %) low protein (below 45.0%) Adulteration with calcium sources (calcite, marble stones).
Hypro Soya - 50%	372	16	4.30	High moisture, low protein
Fish meal - 40%	72	10	13.89	High moisture, low protein (below 38.0 %), High sand & silica (above 7.0 %) and leather meal adulteration
MBM - 45%	74	11	14.86	High moisture (above 8.0 %), Low protein (below 42.5 %), high sand & silica (above 5.0 %)& leather meal adulteration
DCP	50	3	6.00	Low phosphorous, high sand & silica
Soya oil	40	1	2.50	High FFA & moisture
Rice bran oil	75	2	2.67	Low iodine value (below 120), high moisture & FFA (above 10.0 %)
Tallow	50	3	6.00	High FFA & moisture
<b>Total</b>	<b>2432</b>	<b>191</b>		
		<b>Average</b>	<b>7.85</b>	

## CONCLUSIONS

The physical evaluation of feedstuffs accompanied by chemical analysis help the feed mill operators to produce superior quality feeds at optimum cost. The moisture content of grains procured was maximum during the period from October to December whereas the moisture content was low during the period from April to July. The mean rejection of raw materials consignment was 7.85%. Wide variations in the quality of fish meal, meat and bone meal and vegetable oils were observed as compared to grains and soybean meal. The major reasons for rejection included high moisture, low protein, high levels of sand & silica, adulteration /contamination with foreign materials. The assessment of quality of raw materials at the time of procurement revealed that additional tests are required to ensure feed and food safety.

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