UNIT 2 FEED PROCESSING AND QUALITY CONTROL

Structure

2.0 OBJECTIVES

After studying this unit, you will be able to:

- differentiate between different forms of feed;
- summarize feed compounding and processing; and
- discuss about the storage and quality control measures of poultry feed.

2.1 INTRODUCTION

The commercial poultry requires a complete diet or feed or ration containing a mixture of several feed ingredients either in whole or ground form as per feed formulae. A complete balanced diet is compounded or prepared or processed by involving various stages such as ingredient selection, grinding, mixing, weighing, packing, labelling, storage and transportation. The form of feed may also be of different types such as dry mash, pellet, crumble and wet mash. You will gain some basic information on compounding and processing of feed for poultry from this unit.

2.2 DIFFERENT FORMS OF FEED

Feed offered to birds is often in the form of a complex mixture of whole or partially broken or finely ground ingredients to supply all essential nutrients in recommended levels for optimum growth and production. The compounded or complete feeds may be given to birds in different forms. Some of the common forms of feed are detailed below:

2.2.1 Dry Mash

Dry mash is complete or compounded feed prepared after mixing several ingredients as per the feed formula (Fig. 2.1). It is the cheapest method of feeding and suitable for *ad libitum* feeding. Stale feed may result in reduced nutritional value and reduced intake, which will be reflected in the rate of growth or production. Stale feeds are prone to mould growth and rancidity. Particle size of the mash mixture affects the water consumption (the coarser the texture, the less water the birds drink). However, the particle size of the mash has no effect on the percentage of water in the faeces. In case of bulkier diet (more fibre), more water is consumed and therefore, more water is eliminated in the faeces.

Fig. 2.1: Dry Mash

2.2.2 Pellet Form

The mash may be compressed by running it through specialized equipment to form pellets of varying sizes (3 to 5 mm). Birds normally consume about 6-8 % more feed when fed pelleted feeds (Fig. 2.2). Broilers spend less time in eating pellets and thus more net energy is available for body weight gain.

Fig. 2.2: Pellets

Advantages

The advantages of pellet feed are as follows:

(a) Results in a saving of 15-20 % of feed wastage compared to mash feeding;

(b) Convenient as it can be directly fed from bags;

(c) Reduces labour and handling cost of feed;

(d) Feed wastage is reduced;

(e) There is no wet feed to attract flies and mould growth;

(f) Having higher nutrient density; and

(g) Reduces bulkiness of feed by 18 %.

Disadvantages

The disadvantages of pellet feed are:

(a) Involves additional cost for machinery;

(b) Destroys Vitamin A;

(c) Increases water consumption; and

(d) Increases cannibalism.

2.2.3 Crumble Form

When pellets are coarsely ground, or preferably run through special cracking rolls, a type of product midway between mash and pellets results. Crumbles are usually made in different sizes (0.5-1 mm).

Advantages: Similar to pellets. Because of the smaller size, it may be fed to younger chicks.

2.2.4 Wet Mash

Addition of water to dry mash results in wet mash. It increases palatability and feed intake but reduces dustiness. It is not very popular in comparison to dry mash. Feeding of wet mash may be good for one or two days, but birds soon learn to adjust for the increased palatability and feed consumption and come back to its normal level. Remember, wet mash feeding may not increase egg production, egg weight, growth and feed conversion significantly.

Check Your Progress 1

Note: a) Use the space given below for your answers.

b) Check your answers with those given at the end of the unit.

1) Write True or False

i) Crumble is a larger pellet. .....

ii) Mash is a mixture of feed ingredients. .....

iii) Pelleting destroys Vitamin A. .....

iv) Pellet feeding reduces cannibalism. .....

v) Wet mash is prepared by adding water in dry mash. .....

2) What are the advantages of pellet feed?

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Activity 1

Visit a nearby farm and note down the different form of feed used for feeding different types of birds at different age groups.

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2.3 FEED COMPOUNDING

A balanced diet is required to achieve optimum conversion rate and it requires several steps to get the complete or compounded feeds for different categories of birds. It should not be restricted to feed formulation only as the balanced feed formulated should not be ensured that it will give better result. It is always essential that a proper processing (compounding or milling) of a complete feed has been subjected to several steps of screening at the farm or feed mill. The feed prepared at home or in your own farm or feed mill should be of guaranteed quality, fresh and cheaper.

2.3.1 Choosing the Raw Materials

The quality of the feed mainly depends on the selection of ingredients (raw materials). Therefore, you should give much importance while selecting the feed ingredients for formulation and preparation of compounded poultry feed. Ingredient choice is usually directly related to their availability, relative cost, standard quality and suitability. Palatability is quite important and it may be natural in the feedstuff, but it may be influenced by adulterants (bran, husk, silica, weed seeds etc.), moisture content, fungal infestation etc. A cheaper product but low in nutritive value and having toxic factors should not be included in poultry feed at any cost. In our country, the quality of feed can be judged based on the specifications laid down by two agencies *viz*., BIS and Compound Livestock Feed Manufacturers' Association (CLFMA). Nutrient specifications for different common raw feed ingredients have been summarized in Table 2.1.

Table 2.1: Nutrient Specifications for Purchase of Some Common Raw Materials

Feed Ingredients	Specifications
Dicalcium Phosphate	Moisture 7% (maximum), Acid Insoluble Ash 1% (maximum), Fluorine 0.1% (maximum), Calcium 23% (minimum), Phosphorus 18% (minimum)
Fish Meal	Moisture 10% (maximum), Protein 45% (minimum), Sand and Silica 5% (maximum), Salt 3% (maximum), Urea Nil
Groundnut Cake Expeller	Moisture 10% (maximum), Fat 7% (minimum), Protein 42% (minimum)
Groundnut Cake Extraction	Moisture 10% (maximum), Protein 45% (minimum), Sand and Silica 3% (maximum),
Maize	Moisture 12% (maximum), free from fungal growth and insect damage
Meat-cum-Bone Meal	Moisture 10% (maximum), Calcium 10% (minimum), Protein 45% (minimum), Phosphorus 5%, (minimum) free from pathogenic organisms
Mustard Oil Cake (Deoiled)	Moisture 10% (maximum), Fibre 12% (maximum), Protein 35% (minimum), Sand and Silica 3% (maximum)
Rice Bran (Deoiled)	Moisture 10% (maximum), Fibre 10% (maximum), Protein 13% (minimum), Sand and Silica 5% (maximum)
Rice broken	Moisture 10% (maximum), Fibre 3% (maximum), Sand and Silica 5% (maximum), Free from insects, husk and stones
Rice Polish	Moisture 10% (maximum), Fat 16% (minimum), Fibre 8% (maximum), Sand and Silica 5% (maximum), Free from rancid odour
Soybean Meal	Moisture 10% (maximum), Fibre 6% (maximum), Protein 45% (minimum), Sand and Silica 3% (maximum) Urease activity 0.5% (maximum)
Sunflower Meal Extraction	Moisture 10% (maximum), Fibre 22% (maximum), Protein 28% (minimum), Sand and Silica 5% (maximum)

2.3.2 Feed Milling Process

Preparation of mixed feed requires a FEED MILL (small, medium or large units depending upon need) comprising of grinder and mixer. The size of the mill is expressed in terms of tonnes of feed produced per hour such as 1, 2, 3 or 4 tonnes per hour. There are two systems of milling:

(a) Volumetric System: Also called as continuous automated system for grinding and mixing and is based on the supply of ingredients metered directly to grinder and mixer on a continuous flow basis. Such a system does not require weighing of each ingredient one by one.

(b) Batch System: The ingredients are ground separately, weighed as per feed formula, and a batch of appropriate size is made depending upon the capacity of mixer. Generally, the batch system is followed as it is cheaper.

The various steps involved in feed compounding are as follows:

(i) Weighing: The selected feed ingredients are weighed individually with the help of mechanical or electronic weighing balance to achieve the desired quantity. Weighing of each ingredients as per the formulation to constitute one batch of 1 or 2 tonnes is done manually in smaller feed plant, while in large feed plant it is done by an auto-weighing system.

(ii) Grinding: Grinding is a process of reducing the particle size of feed which helps the digestive enzymes to act effectively and quickly. The size of particle depends upon the shape, size and hardness of the seed and age of the birds. Coarse grinding is done for adult birds, whereas, fine grinding (powdering) is done for young chicks. Chick performance is optimum in medium particle size of l.13 - 1.23 mm than 0.57 to 0.67 mm. Fine grinding of feed ingredients may result in reduced gizzard weight, gizzard pH, and pH of intestinal contents. Rate of passage of feed is also increased if finely ground. To avoid pathological changes (beak deformities), the minimum particle size of the poultry feed should be less than 1 mm in diameter.

There are two types of feed mills or feed grinders. The first type is called **Hammer Mill** (Fig. 2.3), which is mostly used for grinding the ingredients with the help of rotating metal bars (hammers) that beat the ingredients into small or fine particles (2 to 5 mm in diameter). The other type is known as **Roller Mill** (Fig. 2.4), which acts on grains by compressing it between two smooth or corrugated rollers that can be screwed together to produce smaller particles. With grains such as maize or sorghum, the product size can range from crushed grain to a fine powder.

Fig. 2.3: Hammer mill

Fig. 2.4: Roller mill

(iii) Pre-mixing: In feed formulations, feed additives, growth promoters, medicines, trace minerals, vitamins etc. are often used in very small quantities i.e. mg/kg or mcg/kg. The trace materials are first premixed separately in an efficient small batch of cereal or feedstuff to form a pre-mix and again mixed with other feed ingredients to form a larger portion of pre-mix. The process is continued till the volume becomes 5 to 10 kg. Such process is called 'pre-mixing' and the mixed material is called 'pre-mix'. The pre-mix is then added to the main batch of mixed lot to achieve uniform distribution.

(iv) Mixing: Feed ingredients are generally mixed together in a mixer to provide a nutritionally balanced diet. While farm mixing, the ground ingredients are piled up in layers on the pucca floor, the largest ingredient at bottom and others over it as per their quantity. The premix and mineral supplements are added on top. Then, the ingredients are mixed either by hand or shovel, till a uniform mixture is obtained. At least 3 to 5 turnings are required for proper mixing. The lot should be small for efficient mixing. The molasses and fat are mixed before mixing into whole lot to prevent formation of mass. Fat is melted by heating to 40 to 50°C and then mixed. Combined mill and grinding or mixing units are now available that have a capacity to produce about 100-500 kg of feed per hour specially designed for the farm mixer and these units are comparatively less expensive.

There are two types of batch mixers. The first one is **Horizontal Mixer** (Fig. 2.5), which is preferred because of much higher mixing standard, higher production rate and their suitability in mixing fat and molasses. The mixers size ranges from 0.5 to 2 tonnes per hour. The mixing time per batch is 3 to 5 minutes. The second type is **Vertical Mixer** (Fig. 2.6), which takes more time (15 to 20 minutes) for complete mixing process, consumes more power and is not suitable for mixing micro-ingredients. Mixing fat and molasses is also difficult in vertical type mixer as they tend to stick to the sides and thus efficiency is reduced. The third type is **Continuous type** mixer which is used in continuous flow milling system. Over-mixing or under mixing may cause uneven mixture of feed ingredients.

Fig. 2.5: Horizontal mixer

Fig. 2.6: Vertical mixer

Fig. 2.7: Small scale feed mill

2.3.3 Packing and Labelling

After grinding and mixing, the next step is packaging and labelling.

a) Packing

Packing is the process of binding feed materials into a bundle using a packaging material such as paper or plastic to preserve, store or transport.

(i) Advantages

The advantages of packing are as follows:

(a) Easy and uniform distribution of the products;

(b) Easy handling, storage and transportation;

(c) Easy identification of the products on the basis of colour and markings on the packaging materials, shape and size; and

(d) Supply of weighed quantity (50 to 70 kg).

(ii) Packaging Materials

The different types of packaging materials used for packing the poultry feed are as follows:

(a) Bags and sacks of synthetic materials;

(b) Jute sacks of different capacities;

(c) Air-tight sealed cans;

(d) Paper bags made of multi-layer stiff papers; and

(e) Polypacks for packing semi-moist materials and supplements.

(iii) Steps in Packaging

Filling the product in sacks or other containers

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Weighing the sacks with material to a prefixed weight

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Closing the open end by stitching

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Piling on pallets for facilitating re-handling of packaged products

b) Labelling:

All kinds of standard processed feeds are properly labelled either on the body of bag itself or a label is kept inside the bag before it is sealed giving the following information by the feed manufacturer in consultation with the quality control authority:

(a) Details of the product

(b) Proximate composition

(c) Usage instruction

(d) Storage conditions

(e) Name of the company

(f) Seal of company

(g) Date of manufacture

(h) Batch number

(i) Maximum retail price

Check Your Progress 2

Note: a) Use the space given below for your answers.

b) Check your answers with those given at the end of the unit.

1) Write True or False

i) Grinding is a process of increasing particle size. .....

ii) Hammer is made up of metal. .....

iii) Jute sack is used to pack feed ingredient. .....

iv) Layers prefer fine powdered material. .....

v) Trace minerals are premixed in a carrier. .....

2) Give the maximum moisture level of:

i) Fish meal .....

ii) Groundnut cake .....

iii) Maize .....

iv) Mustard oil cake .....

v) Soybean meal .....

Activity 2

Visit a nearby feed mixing plant and note down the different types of machineries used in feed compounding. Also observe and note down the different types of feed milling operations performed. Collect information regarding the packaging materials used and the labelling procedure.

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2.4 FEED PROCESSING

Feed processing means application of different kinds of treatments for improving the nutritional quality of feedstuffs. Some of the treatments are simple and easy to operate, while others require extensive and elaborate techniques.

The **methods of feed processing** are selected on the basis of:

(a) Nature of feed;

(b) Chemical composition;

(c) Presence of harmful factors;

(d) Economic implications;

(e) Quantity to be processed; and

(f) Use of processed feed ingredients.

Do you know why feed should be processed? The processing of feed has the following advantages:

(a) Improves starch availability and protein utilization;

(b) Eliminates or inactivates the anti-nutritional factors in feed ingredients;

(c) Ensures preservation of nutrients in feed; and

(d) Improves appearance and palatability of feed.

There are two types of processing *viz.* cold and hot processing.

2.4.1 Cold Processing Methods

(i) Grinding

You can refer to descriptions detailed under Sl. No. 2.3.2 (ii) of this Unit.

(ii) Mixing

You can refer to descriptions detailed under Sl. No. 2.3.2 (iv) of this Unit.

(iii) Reconstitution

Reconstitution is a process of conditioning the grains to increase its moisture content to 25-30 % and storing in anaerobic conditions for approximately 21 days. **Advantages:** (a) Results in disruption of the protein matrix of the grain and release of enzymes (amylase and proteases); (b) Improves nutritive value by activating enzymes already present in seeds, moistening, and inactivation (removal) of toxic substances. **Disadvantages:** (a) Cost of drying for wet material; (b) Specialized techniques of anaerobic treatment.

(iv) Soaking in water

Dipping the feedstuffs in sufficient quantity of water for definite period say 12 hours or overnight is known as 'soaking'. Soaking of barley in water hydrolyzes 35-59 % phytate phosphorus, decreases soluble or total beta-glucan content and improves broiler performance. Soaking of rye also reduces the viscosity of the diet and excreta and improves weight gain in broilers.

2.4.2 Hot Processing Methods

(i) Exploding

During exploding, the grain is first subjected to steam at high pressures in a closed chamber and suddenly pressure is decreased to atmospheric pressure resulting into rapid expansion of the grain. Generally, steam pressure of 15.9 to 17.6 kg/cm^2 for 15-20 seconds is used.

(ii) Extrusion

Extrusion is a special method of cooking by applying heat in the form of steam and pressure by means of friction. Extrusion improves the utilization of soybean. Maximum expansion is achieved at 170-200°C with improved digestibility of starch, improved weight gain and feed conversion ratio (FCR) in broilers.

(iii) Heat treatment

For improving the availability of vegetable protein from the poultry diet, heat treatment has to be performed by providing dry heat at 110°C for 30 minutes at 1.345 kg/cm^2

atmospheric pressure. **Advantages:** (a) Heat ruptures the enzyme-resistant carbohydrate-protein bonds and makes the nutrients available for poultry; (b) Increases amino acid availability; (c) Eliminates the heat labile anti-nutritional factors, e.g. trypsin inhibitors, haemagglutinins, saponins etc. in soybean and gossypol in cottonseed meal. **Disadvantages:** (a) Over heating may causes denaturation of proteins; (b) Overheating may lead to browning and reduce protein digestibility and render lysine unavailable.

(iv) Micronization

Micronization involves popping of grain with the application of infrared heat. Microwaves with 3×10^8 to 3×10^{11} cycles per second are used. The temperature of the grain is increased to 149°C. The moisture is decreased to 3%. The trypsin inhibitor is decreased to non-toxic level, the concentration of available carbohydrates are increased.

(v) Pelleting

The processes involved in pellet making include steam conditioning (food is heated to 65-80°C at moisture content of about 17%) to soften feeds, pressing the softened material through a mould of suitable size to turn into pellet, cooling of the pellets by coolers placed below the pelleting machine (Fig. 2.8) and production of crumble in crumbling machine. The pellets or crumbles should be firm and tough to withstand handling in bulk and not break easily. The pellet feeding has become more popular because of the growth of broiler industry and also use of relatively bulkier material in feed formulae.

Fig. 2.8: Pelleting Machine

Advantages: The advantages of pelleting are as follows:

(a) Increased diet-density and feed intake.

(b) Increased digestibility and nutritive value of feed.

(c) Ensures uniform distribution of ingredients and removes the chances of segregation of feed ingredients as it occurs in mash feeding.

(d) There is scope of feeding of non-conventional, high fibrous and less palatable feeds through pelleting

(e) Destroys many anti-nutritional factors present in feed.

(f) Improves growth rate and feed utilization efficiency.

(g) Reduced feed wastage and dustiness.

(h) Pelleted feeds are more attractive to young poults.

(i) Chicks fed pelleted feed spend much less time on eating than on mash.

Pellet Binders: In order to improve the hardness of pellets, certain pellet binders are added which absorbs water from processed pellet and tend to reduce wet droppings and improves growth of young chicks. These include: (a) Cellulose products from wood pulp indus-try; (b) Grain industry by-products; (c) Guar gum meal; (d) Molasses; and (e) Sodium bentonite (anhydrous silicate).

(vi) Popping

Popping is a method of dry hot processing of cereal grains. In this method, the grain seeds are heated by using hot air at 170-260°C for 10 to 20 seconds. In popping, the steam produced inside the seed fills the pores of the starch granules, increases the temperature and pressure and caused swelling and expansion of starch granules. This process affects chemical composition, functional properties and overall quality of the product. In treated grains, the moisture content is almost lost.

(vii) Roasting

It refers to treatment of grains with dry heat, resulting in expansion in volume of grains and increased digestibility. The moisture content of the grains is reduced by 5%. Dry roasting of soybeans improves its nutrient utilization. Improved broiler performance and higher egg production with higher roasting temperature of soybeans has been observed.

Check Your Progress 3

Note: a) Use the space given below for your answers.

b) Check your answers with those given at the end of the unit.

1) Define the following:

i) Popping

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ii) Roasting

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iii) Exploding

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iv) Extrusion

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v) Micronization

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2) Name the processing method:

i) Application of infrared heat. .....

ii) Conditioning the grains to raise moisture. .....

iii) Increasing the density of ground grains. .....

iv) Dipping grains in cold water. .....

v) Particle size reduction of feed. .....

3) Name some of the pellet binders.

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2.5 FEED STORAGE AND QUALITY CONTROL

Feed once procured or produced should be stored in dry and clean place and their quality has to be maintained in order to get maximum out of it. This section deals with the feed storage and quality control.

2.5.1 Storage of Feedstuffs

The feed storage in a feed milling operation is an important aspect of planning or running a feed compounding or manufacturing unit. The storage space depends on the quantity of feed production in the mill. The storage can broadly be categorized into two: Raw material and finished product storage.

(i) Raw Materials

The grains can be stored in bags (Fig. 2.9) or bins or silos. Oil cakes and rice or wheat bran cannot be stored in bins or silos because of their combustible properties which requires proper ventilation while storing. The liquid material (molasses or oils) can be stored in over-ground concrete, metal or steel, wooden tanks or in underground stumps made of brick and cement. Molasses storage tanks should be filled from the bottom. Bottom filling agitates the molasses and helps in preventing accumulation. There should be separate provision for storage of fishmeal, molasses, salt, supplements, feed additives and drugs, and should be stored after proper labelling. The bags of mineral and vitamin supplements should not be mixed together; otherwise their effectiveness will be reduced and therefore should be stored separately. The raw ingredients are stored for long duration, whereas, the finished products for a shorter period.

Fig. 2.9: Maize stored in gunny bags

(ii) Finished Feed

If you are preparing or procuring readymade feed, it is always advisable to store different type of poultry feeds as per the age groups of the birds. This means that the broiler feed should be stored in a separate bag with that of layer feed. A minimum storage period is recommended for finished product and this can be done by keeping the stock sufficient for 2 to 3 days.

(iii) Storage Conditions

Proper ventilation of the godowns is a must (Fig. 2.10). Otherwise, the ingredients will be spoiled due to excess of moisture or fungal growth. If possible, the gunny bags may be kept over a wooden platform (Fig. 2.10) so that the ingredients may not absorb moisture from the floor (kuccha/mud/brick/cement). The godown must be dry and rat proof, with provision for airtight arrangement required for fumigation at regular interval (usually on every six months). Stacking should be done 1 to 2 feet away from the wall and between stacks to allow adequate room for cleaning and pest control. The temperature should be between 15 to 20°C and humidity up to 60-65%.

Fig. 2.10: Feed Godown with proper ventilation

(iv) Fumigation of Stores

Before storing the grains and feeds, the stores must be thoroughly cleaned. The cracks and holes must be filled. The old plaster should be replaced with a new one, if cracked. The walls, ceiling and floor should be sprayed with 0.5% Malathion emulsion (100 ml Malathion-50 Emulsifiable Concentration (EC) in 10 litres of water). Fumigation is done with Alphos, Celphos, Phosfume or Quickphos @ 1 tablet (3g) per tonne of grain or 7 tablets per 1000 ft ($28m^3$) space for an exposure period of 7 days only, if safe and airtight stores are available. Ethylene dibromide (ED) ampoules, available in 3, 6, 15 or 30 ml packs may also be used @ 3 ml per 100 kg of grains.

Precautions while fumigating:

The precautionary measures to be taken while fumigation is listed below:

(a) Should be performed only by trained persons;

(b) Should be performed only in airtight stores;

(c) If safe and airtight stores are not available, grain can be fumigated under the cover of airtight tarpaulin outside the living room;

(d) Never smell the fumigants;

(e) Wash hands immediately after the operation;

(f) Warn the people not to come near the fumigated stores;

(g) Do not enter the fumigated stores for 6-8 hours after opening it, so that all the traces of the fumigants are replaced by fresh air.

2.5.2 Quality Control

The economical production of eggs and meat by poultry depends primarily on proper

nutrition, quantity and quality of the feed. First of all, you will learn what is quality? The quality has been defined by various individuals as "fitness for use" or "meeting an expectation" or "degree of excellence or "conforming to a standard."

There are some factors that influence the feed quality such as:

(a) **Presence of contaminants and adulterants** - bran, chips, husk, silica, weed seeds, etc.

(b) **Variations in nutrient contents** - likely to be changed due to difference in varieties, processing methods employed etc.

(c) **Degree of grinding**- fine grinding increases dustiness and rate of feed passage but decreases palatability.

(d) **Storage conditions**- changes in moisture content, over heating, rancidity, fungal growth, insect and mites infestation etc. may result in poor storage conditions.

(e) Microbial load and production of toxins and presence of anti-nutritional factors.

(f) Prevention of rodents and birds for checking possible contamination.

(g) Cleaning of the mill, sanitation programme for the machinery, godowns and premises.

(i) Physical Evaluation

This is the easiest method and more rough in nature. Physical examination of feed ingredients or finished feed should be done for appearance, colour, homogeneity of mixing, moisture, odour, particle size, segregating tendency and texture etc. Change in the colour of material gives indication of the storage condition, maturity, sand-contamination, presence of toxins etc. In case of sorghum, its orange to red colour indicates more tannin content. Size of grains indicates the ME content. The smaller the grain, the lower the ME value because of increased proportion of the seed coat. The grains should be whole in nature, but not having broken grain, eaten or shrunken. Feed ingredients should be free from dirt, dust, feathers, fluff, husk, nails, broken wooden parts, lumps, plastic pieces, pesticide residue, fungal contaminants. Younger chicks may not eat coarse particles, whereas the layers will prefer to eat granular and cracked cereals. Bulky and fibrous feeds, though relatively cheap have low nutritive value. The stale and dusty feeds are uneconomical to use as they are not palatable. The raw ingredients should not smell bad otherwise this will cause damage to the finished product. Rancidity should also be thoroughly checked especially in fat. Open bags should not be accepted as it may give chance for adulteration and weight loss.

(ii) Sampling

Sampling is the most important part in quality control as the rejection or acceptance of the lot depends on the assessment in quality of representative sample of the lot. Selected bags should be at least 5-10% of the total number of bags purchased. The sampling of feed ingredient is usually done by drawing samples of about 10 to 20 grams each from 3 to 4 different places of the selected bags through tapered metallic scoop. The drawn quantity of feed from various selected bags is thoroughly mixed. Out of this mixed lot, about 50 to 100 grams of feed sample is packed in plastic bags and then sealed properly into paper envelope. Packing in plastic bags helps in the protection of feed sample from moisture contact. The envelopes should be labelled with sample number, name of the ingredient, date of sample collection and attributes for analysis. This sample can be sent to a reputed and well equipped feed analytical laboratory of your area or neighbouring zones.

(iii) Analysis of attributes

The feed sample should be analyzed for proximate principles (moisture, crude protein, crude fibre, ether extract, total ash, acid insoluble ash), calcium, phosphorus, salt, true-proteins, mycotoxins, urea etc. It is difficult to have a general assumption on published values as the composition varies due to many factors. In specific cases, the amino acids, minerals, vitamins and toxins can also be analysed in advanced type of laboratory.

Check Your Progress 4

Note: a) Use the space given below for your answers.

b) Check your answers with those given at the end of the unit.

1) Write True or False

i) Finished feed is stored for shorter period. .....

ii) Grains are not stored in silos. .....

iii) More salt in fish meal is acceptable. .....

iv) Stale and dusty feed are economical. .....

v) Yellow maize is preferred over white maize in layer ration. .....

2) What are the factors affecting the quality of feed?

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2.6 LET US SUM UP

The commercial poultry requires a complete diet or feed or ration containing a mixture of several feed ingredients either in whole or ground form as per feed formulae. A complete balanced diet is compounded or prepared or processed by involving various stages such as ingredient selection, grinding, mixing, weighing, packing, labelling, storage and transportation. The form of feed may also be of different types such as dry mash, pellet, crumble and wet mash. A balanced diet is required to achieve optimum conversion rate and it needs several steps to get the complete or compounded feeds for different categories of poultry. It should not be restricted to feed formulation only as the balanced feed formulated should not be ensured that it will give better result. It is always essential that a proper processing (compounding/ milling) of a complete feed has been subjected to several steps of screening at the farm or feed mill. There are two types of processing of feed *viz*. cold and hot. The cold processing includes grinding, mixing, reconstitution and soaking in water. The hot processing includes exploding, extrusion, heat treatment, micronization, pelleting, popping and roasting. The feed storage in a feed milling operation is an important aspect of planning or running a feed compounding or manufacturing unit. The storage space depends on the quantity of feed production in the mill. Quality control includes physical evaluation, sampling and analysis of attributes.

2.7 GLOSSARY

Ad libitum : means as much as desired. It is a labour saving system under which poultry help themselves and eat as much as they wish.

Anaerobic : An organism, such as a bacterium, that can live in the absence of atmospheric oxygen.

Batch System of Milling : In batch system, the ingredients are ground separately, weighed as per feed formula, and a batch of appropriate size is made depending upon the capacity of mixer.

Exploding : During exploding, the grain is first subjected to steam at high pressures in a closed chamber, and suddenly pressure is decreased to atmospheric pressure resulting into rapid expansion of the grain.

Extrusion : Special method of cooking by applying heat in the form of steam and pressure by means of friction.

Feed Processing : Application of different kinds of treatments for improvement of nutritional quality of feed.

Grinding : Grinding is a process of particle size reduction of feed.

Micronization : Involves popping of grain with the application of infrared heat.

Palatability : The property of being acceptable to the mouth or taste.

Pallet : A small, low, portable platform on which goods are placed for storage or moving, as in a warehouse or vehicle.

Pelleting : Mechanical process of densification of a ground grain or complete feed with or without application of moisture or steam.

Piling : Lacing one above the other.

Popping : Method of dry hot processing of grains accomplished by raising the temperature of the grains to about 178°C without moisture.

Reconstitution : Process of conditioning the grains to raise its moisture content to 25-30 % and storing in anaerobic conditions for approximately 21 days.

Roasting : Treatment of grains with dry heat, resulting in expansion in volume of grains and increased digestibility.

Stacking : A large, usually conical pile of straw or fodder arranged for outdoor storage.

Stale : No longer fresh, having being kept too long.

Viscosity : The quality or condition of being able to adhere to things.

Volumetric System of Milling : The volumetric system or continuous automated system for grinding and mixing is based on the supply of ingredients metered directly to grinder and mixer on a continuous flow basis.

Wet Mash : Addition of water to dry mash.

2.8 SUGGESTED FURTHER READING

Banday, M.T. and Mondal, S.S. 2002. *Poultry Feeding and Nutrition*. Pixie Publication India (P) Ltd., Karnal.

Mandal, A.B., Yadav, A.S., Johri, T.S. and Pathak, N. 2004. *Nutrition and Disease Management in Poultry*. International Book Distributing Company, Lucknow.

Saxena, H.C. 1997. *Poultry Feed Technology (Feed Formulation and Manufacturing)*. International Book Distributing Company, Lucknow.

Saxena, U.C. 2000. *A Handbook of Poultry Feeding and Management*. Pixie Publication India (P) Ltd., Karnal.

2.9 REFERENCES

Banday, M.T. and Mondal, S.S. 2002. *Poultry Feeding and Nutrition*. Pixie Publication India (P) Ltd., Karnal.

Mandal, A.B., Yadav, A.S., Johri, T.S. and Pathak, N. 2004. *Nutrition and Disease Management in Poultry*. International Book Distributing Company, Lucknow.

Saxena, H.C. 1997. *Poultry Feed Technology (Feed Formulation and Manufacturing)*. International Book Distributing Company, Lucknow.

Saxena, U.C. 2000. *A Handbook of Poultry Feeding and Management*. Pixie Publication India (P) Ltd., Karnal.

2.10 ANSWERS TO CHECK YOUR PROGRESS

Check Your Progress 1

1) i) False

ii) True

iii) True

iv) False

v) True

2) The advantages of pellet feed are as follows:

(a) Results in a saving of 15-20 % of feed wastage compared to mash feeding;

(b) Convenient as it can be directly fed from bags;

(c) Reduces labour and handling cost of feed;

(d) Feed wastage is reduced;

(e) There is no wet feed to attract flies and mould growth;

(f) Having higher nutrient density; and

(g) Reduces bulkiness of feed by 18 %.

Check Your Progress 2

1) i) False

ii) True

iii) True

iv) False

v) True

2) i) 10%

ii) 10%

iii) 12%

iv) 10%

v) 10%

Check Your Progress 3

1) i) Popping is a method of dry hot processing of grains. It is accomplished by increasing the temperature of the grains to about 178°C without moisture.

ii) Roasting refers to treatment of grains with dry heat, resulting in expansion in volume of grains and increased digestibility.

iii) During exploding, the grain is first subjected to steam at high pressures in a closed chamber, and suddenly pressure is decreased to atmospheric pressure resulting into rapid expansion of the grain. Generally, steam pressure of 15.9 to 17.6 kg/cm^2 for 15-20 seconds is used.

iv) Extrusion is a special method of cooking by applying heat in the form of steam and pressure by means of friction.

v) Micronization involves popping of grain with the application of infrared heat. Microwaves with 3×10^8 to 3×10^{11} cycles per second are used.

2) i) Micronization

ii) Reconstitution

iii) Pelleting

iv) Soaking

v) Grinding

3) Cellulose products from wood pulp industry, Grain industry by-products, Guar gum meal, Molasses and Sodium bentonite (anhydrous silicate).

Check Your Progress 4

1) (i) True

   (ii) False

   (iii) False

   (iv) False

   (v) True

2) The factors affecting the feed quality are as follows:

   (a) **Presence of contaminants and adulterants** - bran, chips, husk, silica, weed seeds, etc.

   (b) **Variations in nutrient contents** - likely to be changed due to difference in varieties, processing methods employed etc.

   (c) **Degree of grinding**- fine grinding increases dustiness and rate of feed passage but decreases palatability.

   (d) **Storage** - moisture content, over heating, rancidity, fungal growth, insect and mites infestation etc.

   (e) Microbial load and production of toxins and presence of anti-nutritional factors.

   (f) Prevention of rodents and birds for checking possible contamination.

   (g) Cleaning of the mill, sanitation programme for the machinery, godowns and premises.