MODULE-9: FORMULATION OF RATIONS AS PER BUREAU OF INDIAN STANDARDS (BIS), NATIONAL RESEARCH COUNCIL (NRC) AND AGRICULTURAL

Learning objectives

This module will widely cover all aspects of ration formulation and also discuss on the various methods that can be used for ration formulation.

RATION FORMULATION

- A ration is the feed allowed for a given animal during a period of 24 hours. The feed may be given at a time or in portions at intervals.
- Ration formulation is a process by which different feed ingredients are combined in a proportion necessary to provide the animal with proper amount of nutrients needed at a particular stage of production.
- It requires the knowledge about
    - Nutrients
    - Feedstuffs
    - Animal
- in the development of nutritionally adequate rations. When consumed in sufficient amount will provide the optimum level of production at a reasonable cost.
- The ration formulated should be palatable and should not cause any serious digestive disturbance or toxic effects to the animal.
- The nutrient requirements can be arrived using feeding standards.
- The list of commonly available feeds in that region should be prepared.
- The nutritional value of the feeds can be obtained from any standard source such as NRC.
- Using the above information rations can be prepared by several methods that include
    - Pearson Square Method
    - Two-by-two Matrix method
    - Trial and Error Method and
    - Linear Programming (LP)
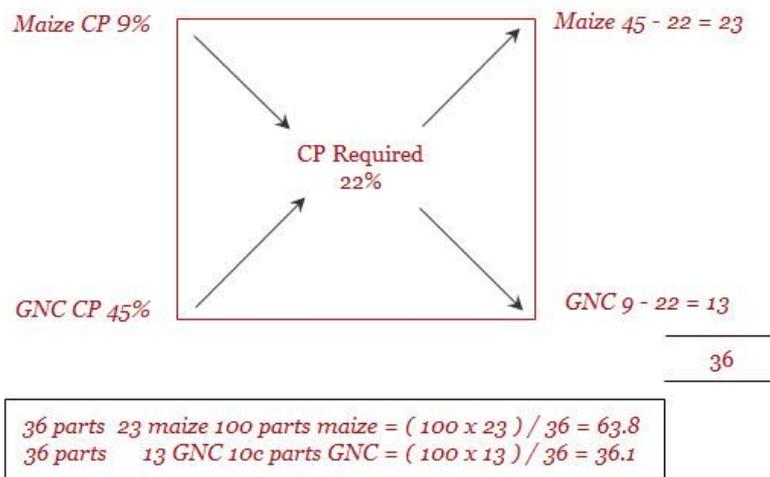   **Factors to be considered in ration formulations**

- Acceptability to the animal - The ration formulated has to be palatable.
- Digestibility - The nutrients in the feed should be digestible and released into the gastrointestinal tract to be utilized by the animal. Rations with high fiber content cannot be tolerated by poultry and swine.
- Cost - The requirement of the animal can be met through several combinations of feed ingredients. However, when the costs of these ingredients are considered, there can only be one least-cost formulation. The least-cost ration should ensure that tile requirements of the animal are met and the desired objectives are achieved.
- Presence of anti-nutritional factors and toxins. The presence of anti-nutritional factors in the feed affects the digestion of some nutrients and makes them unavailable to the animal. The inclusion of these feed ingredients should therefore be limited in the formulation.
- Other factors that should be considered are texture, moisture and the processing the feed has to undergo.

SQUARE METHOD

- This is relatively simple and easy to follow. It satisfies only one nutrient requirement and uses only two feed ingredients.
- The limitation however is that the level of nutrient being computed should be intermediate between the nutrient concentration of the two feed ingredients being used.
- It is of greatest value when only two ingredients are to be mixed.
- The nutrient requirement is noted in the middle of the square this value in the middle of the square must be intermediate between the two values that are used on the left side of the square which are actually the nutrient content of the two ingredients that are to be used.
- For example, the 14 percent crude protein requirement has to be intermediate between the soybean meal that has 45 percent crude protein or the maize that has 10 percent crude protein.
- Subtract the nutrient value from the nutritional requirement on the diagonal and arrive at a numerical value and note it down on the right side of the square.
- Two sets of values will be got.
- By summing those parts and dividing by the total, you can determine the percent of the ration that each ingredient should represent in order to provide a specific nutrient level.

Pearson Square Method

Maize CP 9%   Maize 45 - 22 = 23

CP Required
22%

GNC CP 45%   GNC 9 - 22 = 13

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36

36 parts 23 maize 100 parts maize = (100 x 23) / 36 = 63.8
36 parts   13 GNC 10c parts GNC = (100 x 13) / 36 = 36.1

Using More Than Two Ingredients

- It is possible to prepare ration with more than two ingredients using the Pearson square.
- For example, to prepare a 15 percent crude protein mixture that consists of a supplement of 60 percent soybean meal (45 percent crude protein) and 40 percent ground nut oilcake (45 percent crude protein), and a grain mixture of 65 percent corn (9 percent crude protein) and 35 percent sorghum (12 percent crude protein), the following steps are followed. Since only two components can be used in the Pearson square method, the ingredients are combined first as follows:

60% SBM x 45% crude protein	=	27.0
40% GNC x 45%	=	18.0
Protein in supplement mixture		45.0%
65% corn x 9.0%	=	5.85
35% sorghum x 12.0%	=	4.20
Protein in grain mix		10.05%
5.0 parts x 60%	=	3.0 parts SBM
5.0 parts x 40%	=	2.0 parts GNC
30.0 parts x 65%	=	19.5 parts corn
30.0 parts x 35%	=	10.5 parts Sorghum
		35.0
(3.0 / 35.0)	=	8.57% SBM
(2.0 / 35.0)	=	5.71% GNC
(19.5 / 35.0)	=	55.72% corn
(10.5 / 35.0)	=	30.00% sorghum

TWO-BY-TWO MATRIX METHOD

- This method solves two nutrient requirements using two different feed ingredients. A 2 x 2 matrix is set and a series of equations are done to come up with the solution to the problem.

TRIAL AND ERROR METHOD

- This is the most popular method of formulating rations for swine and poultry.
- As the name implies, the formulation is manipulated until the nutrient requirements of the animal are met.
- This method makes possible the formulation of a ration that meets all the nutrient requirements of the animal.
- Greater control can be had on implementing restrictions and judging inclusion levels
- It is a time consuming method involving a lot of calculations and meeting out specifications may not be very precise.

LINEAR PROGRAMMING (LP)

- This is a method of determining the least-cost combination of ingredients using a series of mathematical equations.
- There are many possible solutions to each series of equations, but when the factor of cost is applied, there can only be one least cost combination.
- An electronic computer is capable of making thousands of calculations in a very short time.
- However, the machine is incapable of correcting errors resulting from incorrect data and errors in setting up of the program.
- Therefore, the resultant rations obtained from linear programming will be no better than the information and values which are entered into the computer.
- There are many feed formulation software packages available in the market. The software range from simple, spreadsheet-based solutions to sophisticated and complex packages designed for large feed manufacturers that require multi-site, multi-server, and multi-blending capabilities.

Inputs required for formulating least cost rations using linear programing

- Details of animal or bird so as to fix their nutrient requirement
    - Species
    - Breed
    - Age
    - Sex
    - Physilogical status
    - Production status
- Ingredients list and their nutritive value
- Critical nutritive ratios eg Ca:P ratio
- Maximum and minimum levels of inclusion of ingredients
- Cost of ingredients

Advantages

- Minimizes the cost of ration.
- It is convenient and saves manpower.
- It is a choice for the commercial feed Millers who handle large no of ingredients.
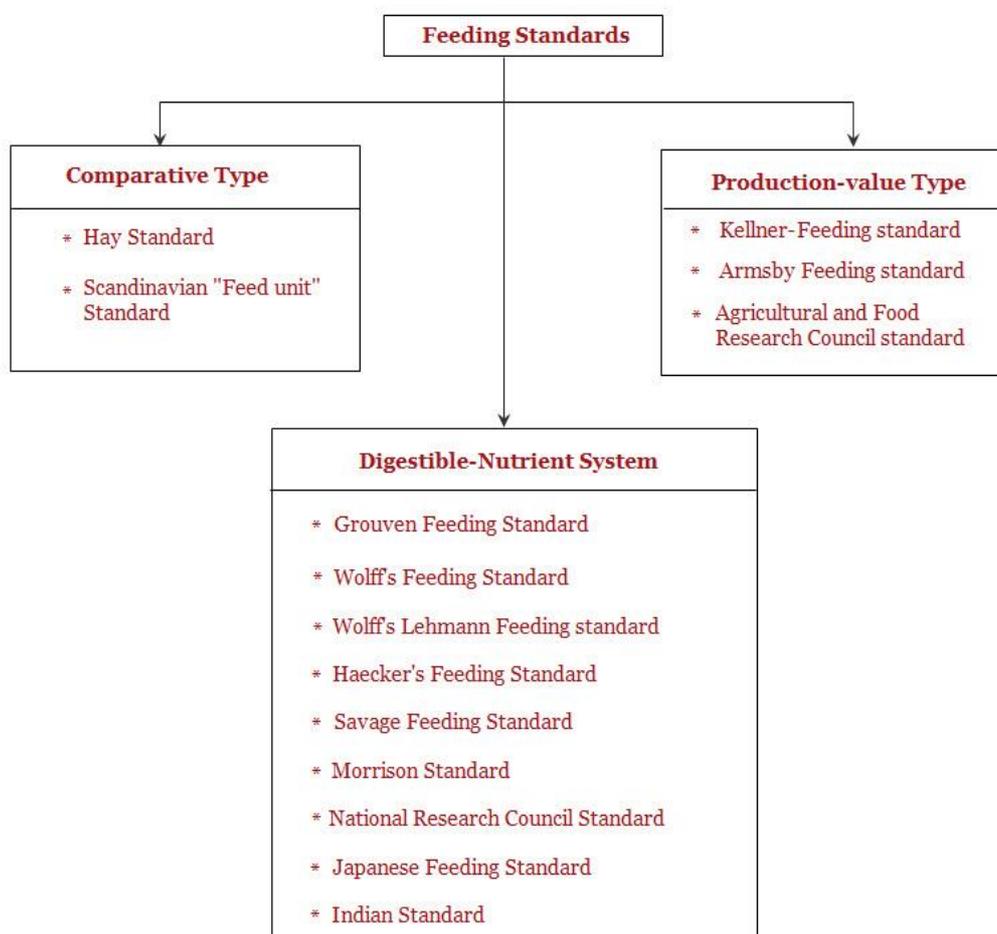- It eliminates human error both in calculation and in speed

Learning objectives

This module will provide information on history, classification, merits and demerits of feeding standards.

FEEDING STANDARDS

- Feedings standards are the tables, which indicate the quantities of nutrients to be fed to the various classes of livestock for different physiological functions like growth, maintenance, lactation and egg production. The nutrient requirements are generally expressed in quantities of nutrients required per day or as a percentage of diet.
- There are two terms, which has been used, in the feeding standards. One is the nutrient allowance and another is the nutrient requirement.
    - The nutrient allowance gives an extra allowance of nutrient over the requirement, which gives a margin of safety.
    - Nutrient requirement gives the requirement for optimum production.
- Feeding standards are grouped under major heading on the basis of principles of the standards such as
    - Comparative type
    - Digestible nutrient system
    - Production value type.

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                    │  Feeding Standards  │
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Comparative Type

* Hay Standard

* Scandinavian "Feed unit" Standard

Production-value Type

* Kellner-Feeding standard

* Armsby Feeding standard

* Agricultural and Food Research Council standard

Digestible-Nutrient System

* Grouven Feeding Standard

* Wolff's Feeding Standard

* Wolff's Lehmann Feeding standard

* Haecker's Feeding Standard

* Savage Feeding Standard

* Morrison Standard

* National Research Council Standard

* Japanese Feeding Standard

* Indian Standard

FEEDING STANDARDS FOR MONOGASTRICS

The common feeding standards used for monogastrics is NRC feeding standars in USA and many other countries and in India we follow Bureau of Indian standards. In UK the ARC feeding standard is also used.

National Research Council (N.R.C.) standard

* National Research Council, USA, recommends a nutrient allowance for differant species of animals.
* The N.R.C. reports for each species is the pooled judgement of a group of experts in the field of species in question.