



Poultry **FEED** Region Specific

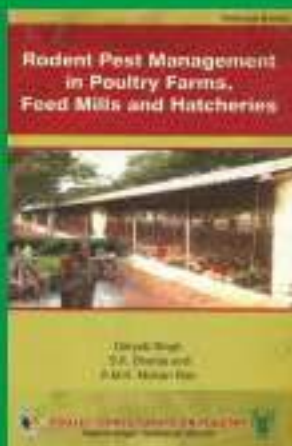
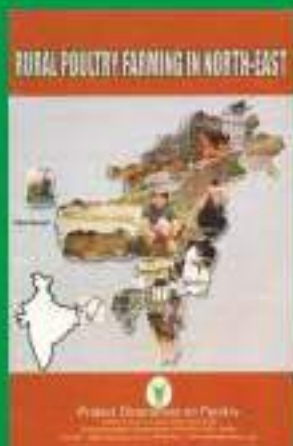
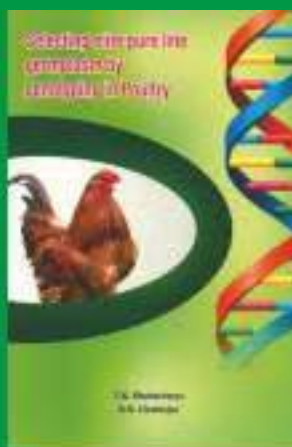
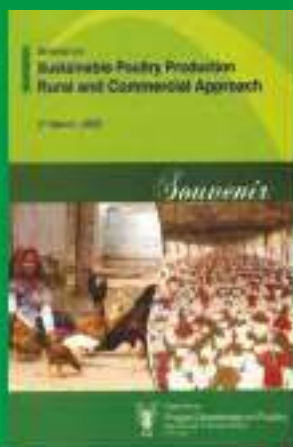
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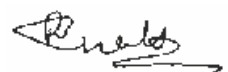
Foreword

Poultry industry in India has recorded phenomenal growth in the last 50 years. As on today, India ranks 3rd in egg production and 5th in meat production globally. The per capita availability of eggs and meat though lower than the recommendations, but the availability has been steadily increasing every year. Considering the wide gap between the current level of consumption and recommended intake the poultry sector needs to grow faster to fill the gap between the availability and requirement for eggs and chicken meat. Moreover, rapid urbanization, increase in per capita income, change in food habits and rising consumer health consciousness are further increasing the demand for eggs and meat.

Feed is the most important and expensive input in poultry production and accounting for 60-75% of production cost. The price of maize and soybean meal, the primary ingredients for poultry production, is highly fluctuating leading to uncertainty in viability of commercial poultry farming. Therefore, it is essential to search for alternative feed ingredients to replace partially the primary feed ingredients in chicken diet. The nutrition group at the Directorate has done commendable research on alternate feed ingredients and has come up with recommendations for their use in routine feed formulation to reduce feed cost and sustain the growth of poultry production.

The Directorate continuously receiving requests from several stakeholders across the country to provide economic and balanced feed formulations utilizing the locally available feed resources. To cater the feed formulation needs of highly diversified stake holders across the country, the authors made an attempt to provides region specific poultry diet for feeding broiler, layer and backyard chicken. In this compendium, the authors have used their vast experience to prepare balanced diets for different types of chicken for different geographical regions of our country. The authors have also provided overview of different nutrients and brief information about various alternate feed resources. I believe that the bulletin is highly informative and immensely useful to the poultry farmers, field veterinarians, students and policy makers to make poultry farming economically more viable and sustainable.

I place on record the appreciations for the research contribution of all the scientists involved in nutrition research at the Directorate since inception of this Institution. I specially appreciate the authors of the bulletin for their efforts in providing the highly useful information for the benefit of poultry stakeholders of our country.



(RN Chatterjee)
Director

Preface

Poultry is one of the fastest growing sectors of the agricultural and development of high yielding layer and broiler varieties together with research in nutrition, management and health care have contributed to the spectacular growth in egg and broiler production in our country. The success of poultry sector depends primarily on the feed which is the most expensive input (65-75%) of poultry production. Providing the precise and balanced nutrition would optimize the feed cost. Typically, poultry feed is formulated with maize and soybean meal as prime energy and protein sources. Considering the issues related with price and availability of these prime feed ingredients, several research groups worked extensively in different parts of the country and recommended safe inclusion levels for various region specific alternate feed ingredients.

In the past few decades, the industrial poultry concentrated in few pockets and is expanding to many consumer centres across the country in the recent past. Utilization of such region specific feed ingredients in poultry diet is beneficial due to the ease of availability and lower cost of the ingredients. In majority of poultry pockets maize and soybean meal (SBM) are available and therefore in all the regions, formulations were made by incorporating maize-SBM at required quantities. In some regions, meat cum bone meal (MBM), rice based dried distillery grains with solubles (DDGS) are available in abundant quantities and therefore, a set of broiler and layer diets were formulated by incorporating MBM and DDGS. Since enzymes especially NSP enzymes and phytase improve nutrient availability, bird performance and reduce feed cost, a set of all the diets were formulated with the enzymes. Considering the similarities in availability of feed ingredients, the country was divided into ten geographic regions to formulate diets suitable for the specific region based on the available feed ingredients in the region so as to enable the poultry farmers to utilize them for poultry production.

In the recent times, the demand for egg and chicken meat from the rural or backyard poultry farming with improved chicken varieties have gained popularity and therefore, a need was felt for providing diets to the backyard poultry.

In this book, we have made efforts to provide an over view on the importance of different nutrients, important feed resources and region specific feed formulation for commercial broilers, layers and back yard chicken varieties. Diets were formulated to contain optimum nutrient concentration for maximum growth and production. The nutrient requirements for chicken during different production phases as suggested by ICAR (2013) were considered in the feed formulation. However, based on newer research findings and practical feasibility, authors modified the values for some nutrient. The analysed composition of major nutrients (essential amino acids and minerals) for different feed resources were also considered while formulating the diets. We hope the information contained in the book will be useful to the poultry farmers, field veterinarians, students and policy makers to make poultry farming economically more viable and sustainable in way to provide nutrient rich poultry products to all the sections of the society.

Authors

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The modern commercial poultry farming is expanding in all parts of the country including hilly regions, which used to depend on the southern states for the past few decades for their egg and chicken meat requirement. This expansion in to the newer areas was largely due to the increased demand for meat and eggs, and also due to the increased awareness about the nutritional benefits of these poultry products. Feed is the most expensive input in poultry production chain. Providing the precise and balanced concentrations of nutrients would optimize the feed cost per unit egg mass and chicken meat production. Knowledge about the nutritional requirement of chicken at different ages, production systems, nutritional value of various feed ingredients, limitations and strengths of alternate feed ingredients, environment variables, the interaction between nutrition and gut development, potential benefits of existing and novel feed additives, etc. is important to formulate the diets with maximum efficiency, which eventually improve the production efficiency of both intensive and rural poultry production systems.

Several feed formulation software are available and they became very handy to formulate diets with the required knowledge as indicated above. It happens quite often to make errors in feed formulation with computer software even by the experts having long experience in poultry nutrition and feed formulation. Such errors, usually end up with compromised production, health issues to the birds and huge financial losses in commercial poultry farming. Another major limitation to make precise feed formulation is the inherent variability in composition of alternate feed ingredients for maize and soybean meal. Though the soybean meal is having several natural phytochemical / constituents, majority of them are completely deactivated by toasting the grains prior to oil extraction. The standard operating protocols for roasting of soybean grains was standardized across the globe and hence the quality of soybean meal (SBM) is relatively uniform across the oil extraction plants. Therefore, the performance of chicken fed maize-SBM based diets is higher and uniform than those fed other alternate feed ingredients. The quality and nutrient composition of alternate ingredients vary high due to the variation in cultivar, agronomic conditions and processing method. Therefore, the digestibility and utilization of alternate ingredients are variable and also lower than the prime feed ingredients. The uncertainties of nutritional composition of these feed ingredients make precise feed formulation job very hard. The availability of feed ingredients is region specific and inclusion of such region specific feed ingredients would reduce the cost of feed in that specific region.

Considering the above mentioned practical limitations in the balanced feed formulation, an attempt was made to formulate diets specific to different geographic regions of the country using the locally available major feed ingredients suitable for poultry feeding. The nutrient requirements for chicken during different production phases as suggested by ICAR (2013) were considered in the feed formulation. However, the authors deviated while fixing the concentrations of certain nutrients based on the merit of research findings and practical feedback from the poultry farmer. The analysed composition of major nutrients including essential amino acids and minerals was considered while formulating the diets. The research and practical experience of authors also prevailed while selecting the optimum levels of feed ingredients especially when more than one alternate feed ingredient were included simultaneously and requirements of nutrients needed in practical diets.

Three basic inputs are needed for chicken feed formulation. 1. Nutrient requirement of the bird, which depends on the strain, variety, age of the bird and its average feed intake, 2. Availability of feed ingredients which largely depend on the geographic region and 3. Cost of the ingredients. Primary assumption was that the cost of alternate feed ingredients is usually lower than the prime feed ingredients per unit of nutrient.

The recommendations made by the ICAR (Nutrient Requirements of Poultry 2013) for chicken was considered as the nutrient requirements for the feed formulation for commercial broiler and egg laying chicken for different production phases. However, considering the practical conditions, concentrations of protein, available phosphorus, lysine, methionine + cysteine, arginine, sodium in broiler (Table 1), metabolizable energy and sodium in layer grower, certain mineral concentrations (calcium, phosphorus and sodium) in layer diets were modified (Table 2) so as to meet the production needs of the birds, and to address the environmental concerns and economic benefits to the poultry farmers without compromising the bird performance. The digestible amino acid concentrations were utilized while formulating the diets. The digestible coefficients as suggested by Evonik (2019) were considered for calculation of digestible amino acid concentrations in various feed ingredients.

In this bulletin, formulations were made for commercial broilers, egg producing layers and backyard chicken varieties. For broiler chicken, diets were made for three phases i.e. pre-starter (1-14 d), starter (15-28 d) and grower (29-42 d of age). In this bulletin, formulations were made for egg laying chicken (Table 2) for five phases that include chick (1-8 weeks), grower (9-16 weeks), pre layer (17-20 week), young layer (21-45 week or 92% egg production) and middle / old layer (46-90 weeks of age). Nutrient requirements of layers used for formulating diets is given in Table 3. Though the diets were formulated based on assumed digestible amino acid concentrations, when higher levels of alternate protein sources were included in diets, drop in performance was observed even when the diets had the standard protein concentration. Therefore, the dietary protein levels were increased marginally when higher levels of alternate protein sources are included in diet.

Table 1. Nutrient requirements for broilers

Nutrient	Age (days)		
	1-14	15-28	29-42
M.E (kcal / kg)	3000	3050	3100
Protein (%)	22.50	21.00	19.00
Dig. Lysine (%)	1.278	1.074	0.974
Dig. Meth+Cyst. (%)	0.946	0.795	0.721
Dig. Arginine (%)	1.368	1.149	1.042
Dig. Tryptophan (%)	0.230	0.193	0.175
Dig. Threonine (%)	0.844	0.709	0.643
Calcium (%)	1.00	0.95	0.85
Avail Phosp (%)	0.45	0.40	0.38
Sodium (%)	0.19	0.19	0.18

In the recent times, utilization of animal protein sources, particularly the fish and fish products is considerably reduced due to the possible contamination, presence of pathogens and vast variability in quality, whereas the meat cum bone meal (MBM) from the slaughter houses of large animal is being used in both layer and broiler diets. The MBM quality though variable, is relatively uniform across different sources and the cost per unit protein is relatively cheaper than the SBM besides added advantage of additional P and Ca facilitate the MBM to find a room in the least cost feed formulation. Therefore, a set of broiler and layer diets were formulated by incorporating MBM up to 5% in the diet. Fish meal is available in abundant quantity in region 3 and hence the same was included in diets of that region.

Table 2. Nutrient requirements for layers

Nutrient	Age (weeks)				
	0-8	9-16	17-20	21-45	46-90
M.E (kcal / kg)	2800	2600	2700	2600	2550
Protein (%)	18.50	15.50	18.0	16.5	15.50
Dig. Lysine (%)	0.89	0.78	0.84	0.72	0.672
Dig. Meth+Cyst. (%)	0.872	0.764	0.823	0.706	0.659
Dig. Arginine (%)	0.89	0.78	0.84	0.72	0.672
Dig. Tryptophan (%)	0.205	0.179	0.193	0.166	0.155
Dig. Threonine (%)	0.685	0.601	0.647	0.554	0.507
Calcium (%)	1.00	0.80	2.00	3.75	3.85
Avail Phosphorus (%)	0.40	0.35	0.32	0.32	0.30
Sodium (%)	0.18	0.18	0.18	0.17	0.17

Considering the similarities in availability of feed ingredients, the country was divided in to ten geographic regions to formulate diets suitable for the specific region based on the available feed ingredients in the region so as to enable the poultry farmers to utilize them in routine poultry production. In all the major poultry production regions, maize, SBM and de-oiled rice bran are usually included in poultry diets when the price of these ingredients is reasonable. Therefore, formulations were made utilizing maize-soybean meal and de-oiled rice bran as standard diets, which can be utilized based on the price and availability. However, quite often the price of these prime ingredients escalates high and the availability and quality will become the major concerns. During such crises, replacement of these ingredients with the available alternate feed ingredients will reduce the cost of diets.

Due to certain limitations (high fibre, plant chemical compounds, low digestibility, quality variations), total replacement of maize and SBM with the alternate ingredients is not possible and hence they were included as a partial replacers for maize and SBM. The number of alternate feed ingredients inclusion in the formula is not uniform among the regions. In some states, many alternate feed resources are available and inclusion of all the alternate feed ingredients in a single formula is not recommended. In such regions, more than one alternate feed formulations (options) were made. Such formulation can be chosen by the poultry farmers based on the availability of feed ingredients in their specific region. The details of regions and availability of feed ingredients in the respective region are given in Table 3.

Table 3. Region number, geographic states and availability of feed ingredients

Region	States	Available alternate feed ingredients
Region 1	Andhra Pradesh, Telangana	Cotton seed meal, sesame/till cake, sunflower meal, groundnut meal, rice broken, sorghum
Region 2	Tamil Nadu, Karnataka	Rice broken, ragi, sorghum, bajra, till/sesame cake, sunflower cake, groundnut cake, silkworm pupae meal
Region 3	Kerala	Tapioca, broken rice, fish meal, groundnut cake, copra meal
Region 4	Maharashtra, Gujarat	Sorghum, broken rice, cotton seed meal, ground nut meal, rape seed meal
Region 5	Rajasthan, Haryana, Punjab	Bajra, wheat broken, rice broken, rape seed meal, guar meal
Region 6	Madhya Pradesh, Chhattisgarh, Uttar Pradesh, Uttarakhand	Wheat broken, rice broken, bajra, rape seed meal, cotton seed meal, guar meal
Region 7	Bihar, Jharkhand	Wheat broken, rice broken, rape seed meal
Region 8	West Bengal, Odisha	Rice broken, rape seed meal, ground nut meal, till/sesame cake
Region 9	Assam, North East Hilly region	Rice broken, sesame / till cake
Region 10	Himachal Pradesh, Jammu and Kashmir	Rice broken, wheat, rape seed meal



Precautions, Considerations and Guidelines

- Diets were formulated with alternate feed ingredients (AFI) available in a specific region. However, such alternate raw materials may be available in other geographic regions. Obviously, the farmer from any region can utilize any formula of other region based on the cost and availability of feed ingredients.
- It is quite common to notice production fluctuations (of about 2-3%) whenever the formulae are changed in the flock for about 4-5 days. Eventually, the production should become normal in maximum 7 days of feeding the new formulae. If the production fall persists beyond a week days, it is essential to review the quality of ingredients used in the formulae and modify as per the need.
- The quality and uniformity of AFI is usually highly uncertain. Therefore, it is essential to routinely analyse (wet chemistry) the proximate principles, fungal toxins, anti-nutritional factor and pesticide residues in every consignment before utilizing them in diet formulation.
- The inclusion levels of AFI in different diets is based on assumption that the ingredients have the standard nutrient profile, adequately processed and are free from toxins, insects, and external contaminants.
- Some AFIs available in the specific region were used at fixed concentration irrespective of their current price due to the ease of availability in the respective regions.
- To realize the expected production, minimum levels of maize and soybean meal were maintained in all the formulations. This was done to ensure minimum availability of essential nutrients to chicken fed AFI, whose quality varies greatly.
- The diets were formulated based on digestible amino acid coefficients in AFI, whose variability is very high. Therefore, any reduction in bird performance can be rectified by incorporating about 10% additional quantity of critical amino acids (lysine, methionine, threonine, valine, isoleucine and arginine) in synthetic form.
- Top up supplementation of fibre hydrolysing (NSP/cocktail) enzymes and protease may also be useful to sustain the bird performance with higher levels of AFI in the diets.
- Inclusion levels of good quality alternate protein sources (APS) depends on the presence of other alternate ingredients in the diet. The levels indicated in the bulletin are the maximum inclusion level, after proper processing to inactivate any anti-nutrients it contained. In presence of other APSs, the inclusion levels should be either reduced or the dietary concentration of CP (1%) or critical amino acids (10%) should be increased or protein hydrolyzing enzymes like protease, papain etc. should be supplemented.
- Inclusion of APS (till/sesame, sunflower, cotton seed meal, DDGS or safflower meal) at about 10% in the diet usually results in improvement in weight gain and feed efficiency compared to those fed the soybean meal as the sole source of protein supplement in broiler diet.
- Insoluble fibre present in sunflower or cottonseed meal were reported to improve the gut development and eventually the bird's performance, whenever dietary fibre levels are lower than about 3%.

Precautions, Considerations and Guidelines

- Cotton seed meal is a new induction in to the poultry diets. It is important to note that fibre levels should be less than 11% and residual oil should be less than 1% in the CSM to get the expected performance.
- **Summer Feeding:** During summer season, the environmental temperature is higher than the comfort zone for chicken. At higher shed temperature, the performance of bird is reduced and it is prone for oxidative stress and immune suppression. To ameliorate the ill effects of the heat stress, it is suggested to increase dietary ME up to 100 kcal/kg to ensure intake of energy as per the requirement. Increasing the energy levels in diet with saturated fat source will be more beneficial over carbohydrate source. Supplementation of chicken diet with KCl (350 g/T), NaHCO₃ (1.5 kg/Ton), betaine (500 g/T), vitamin C (100 g/T), organic Zn, Se and Cr (40 g, 0.15g, 2 g/T, respectively) and vitamin E (80 g/T) during peak summer season will be beneficial to the chicken. Inclusion of NaHCO₃ as a partial source of sodium is beneficial to maintain optimum dietary electrolyte balance during the elevated ambient temperature. Feeding during the early morning (about 4-5 AM) and late evening (about 5-6 PM) is recommended during summer season.
- **Early chick feeding:** Chick should get access to its first feed and water as early as possible soon after hatch. If possible, the first feed should contain highly digestible feed ingredients. Early feeding will stimulate healthy development of chicken gut, proper secretion of digestive enzymes / bile, better growth of immune organs (gut associated lymphoid tissue – GALT) and higher growth and feed efficiency both in broilers and egg laying chicken.
- **Antibiotic growth promoters:** Few gut acting antibiotic or chemical compounds are being used as performance enhancers by certain broiler farmers / integrators. This practice was perhaps adapted as a protective measure for the compromised sanitation and biosecurity in yester days poultry farm premises. In fact, when minimum biosecurity is followed, the so called growth promoters are not required. Due to the integration model of broiler farming, the farm biosecurity improved to the larger extent unlike early 70s and 80s where individual farming was the only broiler production practice. Under better sanitary conditions, inclusion of AGP was reported to depress the growth and feed efficiency as a consequence of disbacteriosis caused by these compounds in the chicken gut. Disbacteriosis leads to reduced digestion, absorption and diarrhoea. Even under the compromised biosecurity, the broiler productivity can be attained / sustained with potential alternative concepts for AGP. Some of such useful approaches include use of direct fed beneficial microbes (bacteria and bacteriophages), insoluble fibre / prebiotics (FOS, GOS, MOS or inert fibre), organic acids (butyric acid, formic acid, lauric acid), essential oils, microbial enzymes (fibre hydrolysing enzymes, protease, phytase), etc. Usually in higher pathogen risk farms, it is recommended to use a combination of the above compounds instead of any single best approach.
- **Essential feed additives:** The basic feed formulae is made to meet the requirement of all essential nutrients like energy, protein, amino acids, fatty acids, macro and micro minerals and vitamins. However, considering the practical challenges associated with the intensive farming of chicken in very large numbers, fortification of the chicken diets with certain feed additives is inevitable. Birds are exposed to environment and pathogen challenges, possible contamination of feed and water with pathogens and

Precautions, Considerations and Guidelines

or chemicals, growth of fungi, immune suppression, stress on function of supportive organs (liver and kidney) are some of the challenges that need additional attention while formulating the chicken diet. Therefore, it is always essential to supplement the chicken diets with anti-oxidants / immune boosters (additional quantity of vitamins and trace minerals), toxin binders and liver tonics to support the bird's health and production. In addition to these additives, additional supplementation of compounds mentioned under Summer Feeding is also needed during heat stress situation.

- **Local Feed Ingredients:** In the current bulletin, attempts were made to formulate the diets utilizing both conventional and alternate feed ingredients available in appreciable quantities, so as to include them for feeding either commercial or backyard poultry. However, several ingredients (like expeller cakes, distillery by-products, agro-forest based products, etc.) are available in small quantities with considerable variation in their nutrient profile. Such ingredients can be included in backyard poultry diets at lower concentrations (less than 5-8%) after assessing their nutrient profile like moisture and protein.



Nutrients and their Functions

The nutrients required for chicken are

- Water
- Carbohydrates
- Fats
- Proteins
- Minerals
- Vitamins

Water

Water is one of the most important nutrients. A bird can live without food longer than it can live without water. Water softens feed and carries it through the digestive tract. As a component of blood (90% of blood content), water carries nutrients from the digestive tract to cells and carries away waste products. Water also helps to cool the bird through respiratory evaporation. A chick is composed of about 80% water. There is no precise quantity requirement for water because several factors affect the amount of water a bird needs: age, body condition, diet, ambient temperature, humidity, water quality and wind velocity. As a rule of thumb, poultry consume twice as much water as feed but the requirement doubles during heat stress.

Carbohydrates

Carbohydrates are the principal energy source for poultry. Among carbohydrates, starch and disaccharides are the primary energy sources for chicken. Sources of carbohydrates in poultry diets include maize, wheat, and other grains. Poultry do not digest cellulose and the non-starch compounds, referred to as crude fiber. Higher level of soluble non-starch polysaccharides (NSP) depresses the bird's performance. They increase the viscosity of digesta, reduce digestion of nutrients and favour the growth of pathogens in the hind gut.

Fats

Fats have 2.25 times the calories of carbohydrates by weight. Fat provides 9 calories of energy per gram, while carbohydrates provide 4. At room temperature, saturated fats are solids and unsaturated fats are liquids. Vegetable oils like rice bran oil, soybean oil and blend of vegetable oils are usually used in the poultry diets. Fatty acids are responsible for cell membrane integrity and hormone synthesis. Poultry have a specific requirement for fatty acids, because of which they are considered as essential fatty acids for poultry. Dietary fat also helps in absorption of fat-soluble vitamins A, D, E, and K. In addition to its role in nutrition, fat is added to feed to reduce dust and to improve the palatability of feed.

Fats, including those incorporated in feed, have a tendency to become rancid. This is an year-round problem, but the risk of feed going rancid is higher during the summer. To prevent feed from going rancid, antioxidants are added to poultry diets containing added fat. A common antioxidant listed on feed labels is ethoxyquin. Inclusion of unsaturated fats may make the diet prone for rancidity and to prevent this problem ethoxyquin or BHA are included in poultry diets.

Proteins & Amino Acids

Proteins are complex compounds made up of amino acids. The digestive process breaks down the protein into amino acids. The amino acids are then absorbed and transported to cells that convert them into specific proteins required by the animal. Proteins are used in the construction of body tissues such as muscles, nerves, cartilage, skin, feathers, beak, and so on. Egg albumen is rich in protein.

Nutrients and their Functions

Amino acids are categorized into Essential and Nonessential amino acids. Essential amino acids are not adequately synthesized to meet the needs of the animal. The nonessential amino acids are those that the chicken can generate in sufficient quantities. There are 22 amino acids found in variable quantities in feed ingredients. Of these, 11 are essential and must be supplied through the feed.

Most feed labels indicate only the percentage of crude protein. Absolute quantities of protein do not indicate the quality of the protein. Protein quality is based on the presence of the essential amino acids. For poultry, methionine and lysine are the two most critical amino acids. Deficiencies of any amino acid will lead to a significant drop in productivity and the health of the flock. Commercial poultry diets are supplemented with crystalline amino acids like DL methionine, L lysine HCl, L threonine, L valine, L tryptophan, L arginine, L leucine and L isoleucine depending on the requirement of specific amino acid in specific poultry diet. Inclusion of more number of crystalline amino acids would facilitate to reduce dietary crude protein requirement.

Minerals

Minerals are essential for bone formation, but minerals are also needed for several biological functions like formation of blood cells, blood clotting, enzyme activation, and energy metabolism and muscle function. Minerals are classified as macro- or micro minerals. Poultry require higher levels of macro-minerals and lower levels of micro-minerals in their diets.

The macro-minerals include calcium, phosphorus, chlorine, magnesium, potassium and sodium. Calcium is needed for bone formation and eggshell quality, blood-clot formation and muscle contraction. Phosphorus is important in bone development and it is part of cell membranes and is required for many metabolic functions. Chlorine is important in the formation of hydrochloric acid in the stomach. Sodium and potassium are electrolytes important for metabolic, muscle, and nerve functions. Magnesium also assists in metabolic and muscle functions.

The micro-minerals include copper, iodine, iron, manganese, selenium and zinc. These micro minerals play essential roles in the body's metabolism. Iodine is required to produce thyroid hormones that regulate energy metabolism. Similarly, zinc is involved in many enzyme-based reactions and iron aids oxygen transportation within the body.

Vitamins

Vitamins are a group of organic compounds which are essential in very small quantities. Vitamins are essential for normal body functions, growth, and reproduction. A deficiency of one or more vitamins can lead to a number of diseases or syndromes. Vitamins are in two categories: fat-soluble and water-soluble. The fat-soluble vitamins are A, D, E, and K. Vitamin A is required for normal growth and development of epithelial tissue (skin and the linings of the digestive, reproductive, and respiratory tracts) and reproduction. Vitamin D3 is required for normal growth, bone development and eggshell formation. Vitamin K is essential for blood clot formation. Vitamin E is a potent anti-oxidant and also helps in immune stimulation. The water-soluble vitamins include vitamin C and the B vitamins. The B vitamins include vitamin B12, biotin, folacin, niacin, pantothenic acid, pyridoxine, riboflavin, and thiamin. The B vitamins are involved in energy metabolism. Poultry can synthesize vitamin C. Vitamin C supplementation, however, has been shown to be useful when birds are stressed.

Energy Sources



Energy is not a nutrient but a property of energy yielding nutrients (carbohydrates, fats /oils etc.) when they are oxidized during normal metabolism. Energy is required by chickens for maintenance of body temperature, growth of body tissues, production of eggs and for carrying out vital physical activities. In case of birds, carbohydrates and fats are the major source of energy. When feed is consumed, these nutrients are digested and assimilated. During these processes, the bound energy is released from the ingredients and becomes available to the body. Poultry cannot digest and utilize complex carbohydrates like non-starch polysaccharides due to lack of enzymes required for their digestion in chicken gastro intestinal tract. The common expression of energy requirement in poultry is metabolizable energy (ME) which is stable and relatively uniform for each feed ingredient.

Birds eat primarily to satisfy their energy needs. Once their energy requirements are met they will not consume any more feed even if the requirements for other nutrients have not been met. Therefore it is necessary to formulate the diet having the required concentration of other nutrients in relation to ME.

Cereal grains and agro-industrial by products are mainly used as source of energy. The energy sources are used at 50-70% in the diet of chicken. The energy feedstuffs are classified as high energy sources (maize, wheat, sorghum, broken rice, fat and oils etc.) and low energy sources (deoiled rice bran, wheat bran, molasses etc.).

Maize is the most commonly used energy source in poultry diets, but other ingredients can be included partly or completely if available at economic price. About one third protein requirement of chicken is also contributed by the energy sources.

Details of common feed ingredients like scientific and colloquial names, production, nutrient and anti-nutrient profile, probable inclusion of different energy sources are given in this bulletin.



Synonyms	: Corn	
Scientific name	: <i>Zea mays</i>	
Local names	: Hindi	: Makka, Makai, Bhutta
	: Marathi	: Makka
	: Tamil/Malayalam	: Makkacholam
	: Telugu	: Mokka javanalu
	: Kannada	: Makkejola
	: Urdu	: Makka

Annual production in India : 28.74 million tons (2017-18)

Major producing states : Karnataka, Maharashtra, Madhya Pradesh, Tamil nadu, Telangana, Bihar, Andhra Pradesh, Rajasthan, Uttar Pradesh, West Bengal

Nutritive value

Maize is the most preferred energy source in poultry diets due to its high energy value, better digestibility, palatability, presence of pigments and essential fatty acids. Presence of natural pigments in the grain contributes yellow color to the egg yolk and chicken meat when it is used at 30% and above in the diet. Maize is very rich in digestible starch, high in oil (3-4%), and low in fibre (<3%). The protein of maize is low in essential amino acids, lysine and tryptophan but reasonably high in methionine. It is also rich in linoleic acid. Several new cultivars of maize like quality protein maize, low phytate maize, high oil maize, etc. also are propagated.

Anti-nutritional factors/ limitations to use

Depending upon the production and storage conditions, the grain is vulnerable for fungal infestation and development of mycotoxins especially in hot and humid areas. Supplementation of toxin binder is recommended. Propionic acid should be added to maize while storing if the moisture content in the grain is higher than 12%. When producing pellets with high maize containing diet, pellet binders, molasses, oil or bran should be included for better pellet quality.

Inclusion in diet (%) (Maximum)

Chick	Broiler	Layer
70	70	70

Nutrient composition (90% Dry matter basis)

Proximate		Amino Acid	Digestible, %	Mineral	%
ME (kcal/kg)	3350	Arginine	0.38	Ca	0.02
CP (%)	8.80	Lysine	0.21	NPP	0.08
CP digestibility (%)	87.00	Meth +Cys	0.33	K	0.32
EE (%)	4.00	Threonine	0.32	Cl	0.09
Lin. acid (%)	1.90	Tryptophan	0.06	Na	0.01
CF (%)	2.2	Leucine	1.01		
Choline (mg/kg)	500	Isoleucine	0.27		
		Valine	0.36		

Synonyms	: Jowar, Milo, Great millet	
Scientific name	: <i>Sorghum bicolor</i>	
Local names	Hindi	: Jowar
	Kannada	: Jola
	Marathi	: Jowari
	Tamil	: Cholam
	Telugu	: Jonnalu



Annual production in India: 4.8 million tons (2020-21)

Major producing states : Karnataka, Maharashtra, Tamilnadu, Rajasthan, Andhra Pradesh, Madhya Pradesh, Uttar Pradesh and Gujarat

Nutritive value

The grain of sorghum is smaller than maize and it contains no xanthophylls. The apparent ME content of sorghum varies from 2600 to 3200 kcal/kg depending on grain variability, fibre and tannin contents. Crude protein, lysine, methionine, calcium and phosphorus contents in sorghum are higher, while ether extract and metabolisable energy contents are lower than maize. Thus feeding value of sorghum is about 95% that of maize. In commercial broiler diets, sorghum (<0.55% tannin) can be included upto 60% without affecting the chicken performance.

Anti-nutritional factors/ limitations to use

The principal deleterious factors in sorghum grain are polyphenolic compounds, known as condensed tannins. Tannin content ranges from 0.2 to 2.0%. Brown sorghum contains higher amount of tannins than white, red or yellow coloured sorghum. Most of the biological effects of tannin are associated with their ability to react with protein. In the digestive tract, tannins react with digestive enzymes and reduce the nutrient digestibility. They also react with dietary proteins forming indigestible complexes. Protein level of diet may need to be increased to reduce deleterious effect of tannins. Since sorghum does not contain xanthophylls, carotenoids should be included in the diet to improve color of egg and meat for the consumer acceptability.

Inclusion in diet (%) (Maximum)

Chick	Broiler	Layer
60	60	60

Nutrient composition (90% Dry matter basis)

Proximate		Amino Acid	Digestible, %	Mineral	%
ME (kcal/kg)	3000	Arginine	0.30	Ca	0.04
CP (%)	9.00	Lysine	0.19	NPP	0.1
CP digestibility (%)	87.00	Meth +Cys	0.29	Na	0.10
EE(%)	3.00	Threonine	0.26	Cl	0.09
Lin. acid (%)	1.13	Tryptophan	0.09	K	0.35
CF (%)	2.0	Leucine	0.96		
Choline (mg/kg)	688	Isoleucine	0.31		
		Valine	0.39		



Synonyms	: Pearl millet
Scientific name	: <i>Pennisetum glaucum</i>
Local names	: Hindi/ Urdu/ Gujarati/ Punjabi : Bajra Kannada : Sajje Rajasthani/Marathi : Bajri Tamil : Kambu Telugu : Sajjalu

Annual production in India: 9.2 million tons (2017-18)

Major producing states : Rajasthan, Uttar Pradesh, Haryana, Gujarat, Madhya Pradesh, Maharashtra, and Karnataka

Nutritive value

The ME content of bajra varies from 2600-3200 kcal/kg, which is lower than maize. Bajra contains more crude protein, 8-14%. The concentration of important amino acids like lysine, methionine, threonine and tryptophan are higher in bajra than maize. It has 4-6% oil and is a better source of linolenic acid. The feeding value of bajra is similar or inferior to maize depending on the cultivar of the grain. Carotenoid supplementation is required at high concentration of bajra in diet. Bajra can be used as total substitute for maize in broiler diets (60%) without affecting growth, feed efficiency and carcass traits. In layer diet, bajra can be used up to 45-60% without affecting age at sexual maturity, egg production, egg weight and body weight gains.

Anti-nutritional factors/limitations to use

Feeding bajra as a sole source of energy tends to increase the fat deposition in liver and abdomen. Higher concentration of methyl donors minimizes fat deposition. Since bajra does not contain xanthophylls, carotenoids should be included in the diet to improve color of eggs and carcass.

Inclusion in diet (%) (Maximum)

Chick	Broiler	Layer
60	60	60

Nutrient composition (90% Dry matter basis)

Proximate		Amino Acid	Digestible, %	Mineral	%
ME (kcal/kg)	3000	Arginine	0.34	Ca	0.07
CP (%)	9.00	Lysine	0.22	NPP	0.1
CP digestibility (%)	91.2	Meth +Cys	0.43	Na	0.04
EE (%)	4.00	Threonine	0.32	Cl	0.14
Lin. acid (%)	1.56		Tryptophan	0.12	K0.43
CF (%)	2.6	Leucine	0.94		
Choline (mg/kg)	793		Isoleucine	0.35	
		Valine	-		



- Synonyms** : Indian millet, African millet, Finger millet
- Scientific name** : *Eleusine coracona*
- Local names** :

Hindi : Nachni

Marathi : Nachani

Kannada : Ragi

Tamil : Kelvaragu/Ragi

Telugu : Ragi

Annual production in India : 1.98 million tons (2017-18)

Major producing states : Karnataka, Tamilnadu, Andhra Pradesh, Telangana, Maharastra,and Uttarakhand

Nutritive value

The ME content of ragi ranges from 2800-3050 kcal/kg. The protein, crude fibre and ether extract contents of finger millets varies widely depending on cultivar, rainfall and other agronomic factors. It contains slightly less protein, fat and more crude fibre than maize. The levels of calcium, phosphorus, methioninine and the total sulfur amino acids are more and lysine is less in comparison with maize. Feeding ragi may increase lean meat content in broilers. Ragi in layer diets reduces cholesterol content in eggs.

Anti-nutritional factors/limitations to use

High crude fibre and tannin content and possibly lower protein quality are the limiting factors in ragi for its utilization in broiler or chick diet. Carotenoids should be included in the diet to improve color of egg and meat.

Inclusion in diet (%) (Maximum)

Chick	Broiler	Layer
10	10	30

Nutrient composition (90% Dry matter basis)

Proximate		Amino Acid	Digestible, %	Mineral	%
ME (kcal/kg)	2900	Arginine	0.30	Ca	0.07
CP (%)	9.00	Lysine	0.19	NPP	0.10
EE (%)	3.00	Meth +Cys	0.39	Na	0.04
Lin. acid (%)	0.50	Threonine	0.29	Cl	0.14
CF (%)	3.9	Tryptophan	0.12	K	0.43
Choline (mg.kg)	793	Leucine	0.57		
		Isoleucine	0.32		
		Valine	0.46		



Synonyms	: <i>Oryza sativa</i>	
Scientific name	: Eleusine coracona	
Local names	Hindi	: Chaval
	Kannada	: Battha
	Marathi	: Tandul
	Tamil	: Arisi
	Telugu	: Varibiyam

Annual production in India : Rice production: 112.76 million tons (2017-18)

Major producing states : West Bengal, Uttar Pradesh, Punjab, Andhra Pradesh, Telangana, Odisha, Chattisgarh, Tamilnadu, Bihar, Assam, Haryana and Madhya Pradesh

Nutritive value

The ME content of broken rice ranges from 2400-3200 kcal ME/kg depending on level of bran and other contaminants. The variation in energy content of broken rice might be due to the wide variation in its nutrient composition. It can be used in the diets of broiler upto 30% without affecting body weight gain, feed intake, feed efficiency and nutrient retention. Feeding of broken rice at higher level may increase carcass fat in broilers and layers. In layers, broken rice can be used as sole source of energy totally replacing maize on weight basis without affecting egg production and feed efficiency.

Anti-nutritional factors/limitations to use

Trypsin inhibitors in some varieties may reduce inclusion levels. Addition of methyl donors may be beneficial. Carotenoids should be included in the diet to improve color of egg and carcass.

Inclusion in diet (%) (Maximum)

Chick	Broiler	Layer
30	30	60

Nutrient composition (90% Dry matter basis)

Proximate		Amino Acid	Digestible, %	Mineral	%
ME (kcal/kg)	3150	Arginine	0.08	Ca	0.08
CP (%)	9.00	Lysine	0.09	NPP	0.09
CP digestibility (%)	76.3	Meth +Cys	0.36	Na	0.07
EE (%)	2.00	Threonine	0.24	Cl	0.08
Lin. acid (%)	0.10	Tryptophan	0.09	K	0.13
CF (%)	3.66	Leucine	0.61		
Choline (mg.kg)	800	Isoleucine	0.29		
		Valine	0.43		



Scientific name : *Triticum aestivum*

Local names : Hindi/Marathi/Urdu : Gehun

Tamil : Godumai

Telugu : Godhumalu

Kannada : Godhi

Sanskrit : Arupa, Bahudugdha, Godhuma

Annual production in India : 99.87 million tons (2017-18)

Major producing states : Uttar Pradesh, Punjab, Madhya Pradesh, Haryana, Rajasthan, Bihar, Gujarat, Maharashtra, Uttarkhand and Himachal Pradesh.

Nutritive value

The use of wheat in poultry diet is limited. It can be used in conditions of surplus production and during scarcity of maize and lower cost. The metabolisable energy varies from 2900- 3150 Kcal /kg, crude protein 10-14%. It is rich in protein and calcium but low in energy and fat as compared to maize. Lysine and threonine are the limiting amino acids in wheat.

Anti-nutritional factors/limitations to use

Presence of non-starch polysaccharide (pentosans) interfere with the digestibility and reduce energy utilization. High levels of wheat can lead to pasty vents and wet litter problem in young chicks. Freshly harvested wheat should not be used in poultry diets. More than 3 months old wheat can be used. Wheat when used should be coarsely ground. Soft wheat grain can be used as total substitute for maize in poultry diet. Supplementation of xylanase, phytase and biotin is essential at higher inclusion levels of wheat in poultry diet.

Inclusion in diet (%) (Maximum)

Chick	Broiler	Layer
20	20	60

Nutrient composition (90% Dry matter basis)

Proximate		Amino Acid	Digestible, &	Mineral	%
ME (kcal/kg)	3000	Lysine	0.31	Ca	0.05
CP (%)	13.0	Meth +Cys	0.46	AP	0.05
CP digestibility (%)	87.8	Arginine	0.27	Na	0.06
EE (%)	3.0	Tryptophan	0.13	Cl	0.05
Lin. acid (%)	0.06	Threonine	0.34	K	0.45
CF (%)	3.0	Leucine	0.71		
Choline (mg.kg)	1090	Isoleucine	0.35		
		Valine	0.46		

Deoiled Rice Bran



Scientific name : *Oryza sativa*

Local names : Hindi : Chokar
Kannada : Akkai towdu
Marathi : Bhat kona
Tamil : Thavidu
Telugu : Tavudu, Chittu

Annual production in India : 8.06 million tons (2017-18)

Major producing states : West Bengal, Uttar Pradesh, Punjab, Andhra Pradesh, Odisha, Telangana, Chattisgarh, Tamilnadu, Bihar, Assam, Haryana and Madhya Pradesh.

Nutritive value

Solvent extracted rice bran or deoiled rice bran (DORB) is generally used in layer diet. The ME value of deoiled rice bran varies from 1300 kcal to 2100 kcal/kg. The crude protein content is higher than maize. The DORB is a valuable and less expensive feedstuff and is routinely used in diets of egg type grower and layers which have lower energy requirement. Because of low ME values it is generally not used in broiler diet.

Anti-nutritional factors/limitations to use

Variation in crude protein, crude fibre and silica limits the use of deoiled rice bran in poultry diet. Trypsin inhibitor and anti-thiamine factors have been detected from rice bran but their effects on chicken performance are reported to be minimal. This rice byproduct is rich in phytate. Phytase supplementation will increase phosphorus release and thereby reduces the DCP requirement in DORB based diets.

Inclusion in diet (%) (Maximum)

Chick	Broiler	Layer
20	20	35

Nutrient composition (90% Dry matter basis)

Proximate		Amino Acid	Digestible, %	Mineral	%
ME (kcal/kg)	1850	Lysine	0.72	Ca	0.12
CP (%)	15.50	Meth +Cys	0.72	NPP	0.17
CP digestibility (%)	77.7	Arginine	1.04	Na	0.04
EE (%)	1.00	Tryptophan	0.17	Cl	0.08
Lin. acid (%)	0.33	Threonine	0.64	K	1.70
CF (%)	18.1	Leucine	1.34		
Choline (mg/kg)	898	Isoleucine	0.67		
		Valine	1.05		

Tapioca Tuber Meal



Synonyms	: Tapioca chips/Tippi, Cassava tuber meal
Scientific name	: <i>Manihot esculenta</i>
Local names	: Hindi : Shakarkand Kannada : Mara genasu Marathi : Prochugaali Chine, Pavde-pharin Tamil : Maravallikkilanku, Allvallikizhangu Malayalam : Kollikkilannu, Maraccini, Marakkilannu Telugu : Karrapendalamu Kannada : Kanagale, Mara genasu, Baragaaladagedde Oriya : Kaatokonda

Annual production in India: 4.949 million tons (2017-18)

Major producing states : Kerala, Tamil nadu, Andhra Pradesh, Nagaland, Meghalaya, Assam, Karnataka, and Odisha

Nutritive value

Tapioca is high in starch with low fibre and protein. The presence of cyanogenic glycosides in the outer skin of the tuber liberate hydrocyanic acid limits its inclusion in poultry diets.

Anti-nutritional factors/limitations to use

Cassava roots contain a glucoside, linamarin, which when acted up on by enzyme liberates prussic acid. The peeled roots contain much less prussic acid than unpeeled roots because most of the prussic acid is in the skin. There are two varieties of cassava: (1) Bitter varieties with roots containing 0.02-0.03% prussic acid. These have to be processed before being used as feed. (2) Sweet varieties with roots containing less than 0.01% prussic acid. These can be used raw for feeding. Most commercial varieties belong to this group. Usually the bitter varieties have longer and thicker roots than the sweet varieties. Inclusion of tapioca at higher levels increases dustiness in the mash feed. Inclusion of molasis or oil in diet will reduce the dustiness of the feed.

Inclusion in diet (%) (Maximum)

Chick	Broiler	Layer
10	10	20

Nutrient composition (90% Dry matter basis)

Proximate	Amino Acid	Digestible, %	Mineral	%
ME (kcal/kg)	2900 Lysine	0.08	Ca	0.21
CP (%)	2.64 Meth +Cys	0.03	NPP	0.02
EE (%)	0.30 Arginine	0.13	Na	
Lin. acid (%)	0.10 Tryptophan	0.02	Cl	
CF (%)	2.2 Threonine	0.06	K	
Choline (mg/kg)	Leucine	0.10		
	Isoleucine	0.08		
	Valine	0.10		

The common vegetable oils used in poultry diet are rice bran oil, soybean oil, palm oil and coconut oil. Blends of animal and vegetable fat are also fed to poultry, which have better proportion of saturated and unsaturated fatty acid ratio. Soapstock which is a byproduct of vegetable oil industry is also used at lower levels (<1.5%) as energy source in poultry feed.

Nutritive value

Fats provide a concentrated source of energy, which contain 7000 to 9000 kcal ME/kg. Addition of fat improves palatability and reduces dustiness of diets. Fat digestibility is affected by fatty acid profile, the level of free fatty acids, degree of hydrogenation and total fat content of diet. Since young birds (<2 weeks of age) have lower ability to digest saturated and hydrogenated fats, ME values vary with age of birds. The unsaturated fats are digested more rapidly than saturated fats. Fat can be added upto 4-6% in broiler ration. During summer, fat can be used to improve the energy density of the chick and layer rations. Low heat increment of fat is also beneficial during heat stress conditions as compared to carbohydrate and protein for chicken.

Anti-nutritional factors/limitations to use

Fat and oils are used for human consumption and hence are expensive to use in poultry feeds. They also require special handling and storage facilities and are prone to oxidation over time. ME value of fat is also variable with factors like bird age, fat composition and inclusion level. Other concerns about fats are their potential for rancidity and effect on carcass composition. Rancidity can influence the organoleptic qualities of fat, as well as color and 'texture' and can cause destruction of other fat soluble vitamins, both in the diet and the bird's body stores.

Inclusion in diet (%) (Maximum)

Chick	Broiler	Layer
1-2	4-6	1-2

Table 4. ME and Fatty acid content of different oil sources

Oil source	ME (Kcal/kg)		Myristi c acid	Palmiti c acid	Stearic acid	Oleic acid	Linolei c acid	Linol- enic acid	Arach- idonic acid
	0-3 weeks	4-6 weeks	C14:0	C16:0	C18:0	C18:1	C18:2	C18:3	C20:4
Rice bran oil	8600	8900	0.8	15.0	7.5	45.0	35.0	0.75	-
Soybean oil	8800	9000	0.25	9.0	4.0	27.0	49.5	8.0	-
Palm oil	7200	8000	1.5	38.0	4.5	45.0	8.0	-	-
Coconut oil	7000	8000	16.0	9.5	2.0	6.5	0.5	-	0.25
Animal vegetable blend	8200	8600	2.0	21.0	15.0	32.0	26.0	0.5	-
Vegetable soapstock	7800	8100	0.5	18.0	3.0	29.0	46.0	1.0	-

Protein Sources



Protein is an essential nutrient in poultry diets. Protein is made up of different combinations of concentrations of both essential and nonessential amino acids. Though protein is essential for chicken and their requirements are expressed as the concentrations of individual amino acids in the precession feed formulation. Preferred protein source in poultry diet is soybean meal (SBM), whose digestibility is relatively high (88%) compared to other vegetable protein sources. The SBM is having higher concentrations of majority of essential amino acids and processed SBM is free from any intrinsic toxic phyto chemicals. The SBM is expensive and prone for contamination with saw dust, sand, soybean hulls, deoiled rice bran, guar meal, etc.

Alternate protein sources for SBM include ground nut meal, rape seed meal, cotton seed meal, til / sesame cake, guar meal, copra meal, distillery dried grain with solubles from rice, etc. can be used as either tital or partial substitute for SBM in chicken diets. Irrespective of economic preference, a combination of SBM with any alternate protein feed ingredients (8-10% in diet) will yield better performance compared to those fed diets with SBM as the sole source of protein supplement in diet. One of the major constraint or limitation with the alternate protein sources is inconsistent quality and higher variability in nutrient and anti-nutrient constituents, which leads to greater variability in bird performance whenever they are used at higher concentrations in the diets. Therefore, it is utmost important analyze the protein quantity and amino acid concentrations in the alternate feed ingredients whenever a new consignment is procured from a new source. Ascertaining the quality of alternative feed ingredients directly from the oil extraction unit is highly beneficial.

Though the use of animal protein sources (fish meal, dry fish, meat cum bone meal) is limited, these ingredients are used in limited quantity in some regions, where they are available. The animal protein sources are high in calcium and phosphorus besides quality protein. Another major limitation with these ingredients is the presence of pathogenic bacteria and probable threat of fat rancidity. Among the animal sources, meat cum bone meal is available at economic proposition, and hence used at 4-5% both in broiler and layer diets.



Scientific name	: <i>Glycine max</i>
Local names	: Hindi : Soya ka kal
	Kannada : Soybean hindi
	Tamil : Soya punnakku
	Telugu : Soyabean pindi

Annual production in India : 8.0 million tons (2020-21)

Major producing states : Madhya Pradesh, Maharashtra, Rajasthan, Karnataka, Telangana, Gujarat.

Nutritive value

Soybean meal is the by-product of the extraction of soybean oil. Solvent extracted SBM is the most commonly used protein supplement in poultry diets. It is the best source of vegetable protein and amino acid composition of SBM is highly suitable for poultry. The protein content of dehulled SBM is 48-50% , while the protein content in solvent extracted SBM with hulls ranges from 42 to 45% depending on the proportion of hulls in SBM. Soybean meal is used in several forms in India like soybean deoiled cake, high protein SBM (high-pro), or full fat soya, but solvent extracted cake is being the most common. Relative to other oil seed meals, the protein is well balanced in terms of essential amino acids for poultry in diets based on cereal grains. It is particularly rich in lysine (2.9%) but deficient in methionine (0.7%). Maize-soybean meal based diet is most popular in broiler feeding and supplementation of synthetic DL-methionine to it makes a complete diet.

Anti-nutritional factors/limitations to use:

Protease inhibitors are allergenic proteins like conglycinin and β conglycinin. Protease inhibitors which are present in raw beans bind with digestive enzymes like trypsin and chymotrypsin making them unavailable for protein digestion. Roasting destroys these antinutritional factors. SBM is sometimes adulterated with rice bran, guar meal, saw dust or urea. Under processing or over processing SBM reduces its nutritive value.

Inclusion in diet (%) (Maximum)

Chick	Broiler	Layer
40	40	30

Nutrient composition (90% Dry matter basis)

Proximate		Amino Acid	Digestible, %	Mineral	%
ME (kcal/kg)	2250	Lysine	2.66	Ca	0.34
CP (%)	46.00	Meth +Cys	1.16	NPP	0.23
CP Digestibility (%)	91.00	Arginine	3.04	Na	0.02
EE (%)	1.00	Tryptophan	0.58	Cl	0.05
Lin. acid (%)	0.49	Threonine	1.60	K	1.83
CF (%)	3.8	Leucine	3.20		
Choline (mg/kg)	2670	Isoleucine	1.93		
		Valine	1.99		



Scientific name : *Helianthus annuus*

Local names : Hindi : Suryamukhi
Kannada : Suryakanti
Marathi : Suryaphul pend
Manipuri : Numitlei
Tamil : Suryakaanti punnaku
Telugu : Poddutirugudu pindi

Annual production in India : 0.069 million tons (2020-21)

Major producing states : Karnataka, Odisha, Haryana, Bihar, Andhra Pradesh

Nutritive value

The nutrient composition of sunflower seed meal (SFM) varies greatly depending upon the dehulling process. The commonly available seed meal in India is un-decorticated and it contains about 25-30% CP and 20-30% CF. Decorticated SFM contains about 40% CP and less than 13% CF. Crude protein content is lower, while the concentration of calcium, phosphorus, methionine and cystine are higher in SFM than SBM.

Anti-nutritional factors/limitations to use:

Low ME and high fibre levels are the limitations of its use. Some SFM may contain higher level of a polyphenolic compound, chlorogenic acid, which is reported to inhibit the activity of digestive enzymes and may affect the performance. Methyl donors like methionine and choline supplementation may nullify the effect of this compound. Lysine and threonine should be supplemented in diets containing high levels of SFM.

Inclusion in diet (%) (Maximum)

Chick	Broiler	Layer
10	10	20

Nutrient composition (90% Dry matter basis)

Proximate		Amino Acid	Digestible, %	Mineral	%
ME (kcal/kg)	1800	Lysine	0.45	Ca	0.14
CP (%)	2.50	Meth +Cys	0.94	NPP	0.14
CP Digestibility (%)	85.00	Arginine	2.49	Na	0.20
EE (%)	1.00	Tryptophan	0.33	Cl	0.10
Lin. acid (%)	0.44	Threonine	0.84	K	0.96
CF (%)	24.9	Leucine	2.39		
Choline (mg.kg)	3791	Isoleucine	1.57		
		Valine	1.79		

Groundnut Meal



Synonym	: Peanut Meal
Scientific name	: <i>Arachis hypogaea</i>
Local names	: Hindi : Moomphly
	Marathi : Bhuemug
	Gujarati : Sing
	Tamil : Kadalai Punnakku;
	Telugu : Verusenaga pindi

Annual production in India : 1.615 million tons (2020-21)

Major producing states : Gujarat, Rajasthan, Tamilnadu, Andhra Pradesh, Karnataka, Madhya Pradesh, Telangana, Maharashtra, West Bengal

Nutritive value

The composition of groundnut meal (GNM) depend on the raw material and the method of oil extraction used. The quantity of hulls present directly affects the fibre and energy content of meal. Solvent extracted ground nut meal contain about 40-45% crude protein and less than 1.5% fat. The fat content of expeller GNM is variable from 3-8% depending on the efficiency of oil extraction. During prolonged storage, the residual oil is easily oxidized resulting in poor palatability, and reduced energy value. The protein content of GNM has suboptimal level of cysteine and methionine. First limiting amino acid in GNM based diet is lysine. It has been reported that a growth factor and an antitrypsin factor occur in GNM. Therefore, supplementation of crystalline amino acids are required to meet the birds requirement.

Anti-nutritional factors/limitations to use:

In the past, GNM was the major source of protein in poultry in our country. Nowadays its usage is limited due to the following reasons. Contamination with aflatoxin, poor amino acid pattern, adulteration with groundnut shell and high cost. It has been reported presence of an antitrypsin factor in groundnut meal. This factor is destroyed by heating. The GNM with aflatoxin levels of less than 20 ppb (parts per billion) can be included in poultry diet. Ducks and turkeys are highly sensitive to aflatoxin, so they should not be fed GNM based diet.

Inclusion in diet (%) (Maximum)

Chick	Broiler	Layer
35	35	25

Nutrient composition (90% Dry matter basis)

Proximate		Amino Acid	Digestible, %	Mineral	%
ME (kcal/kg)	2300	Lysine	1.18	Ca	0.32
CP (%)	45.00	Meth +Cys	0.85	NPP	0.15
CP Digestibility (%)	85.00	Arginine	4.03	Na	0.07
EE (%)	1.00	Tryptophan	0.35	Cl	0.03
Lin. acid (%)	0.29	Threonine	0.99	K	1.15
CF (%)	12.2	Leucine	2.46		
Choline (mg/kg)	1738	Isoleucine	1.29		
		Valine	1.62		



Synonyms : Mustard seed extraction

Scientific name : *Brassica juncea*, *Brassica campestris*, *Brassica napus*, *Brassica*, *Crucifer*

Local names : Hindi : Sarson Marathi : Mohari
Tamil : Kadugu punnaku Telugu : Ava pindi

Annual production in India : 5.105 million tons (2020-21)

Major producing states : Rajasthan, Haryana, Uttar Pradesh, Madhya Pradesh, West Bengal, Gujarat, Assam, Jarkhand, Bihar, Punjab

Nutritive value

Rapeseed meal (RSM) is a fairly good source of CP, energy, low in lysine and rich in methionine as compared to SBM. Both protein content and digestibility are lower than SBM, however, amino acid profile is comparable. The RSM has less lysine and more methionine. Crude fiber content is considerably higher than SBM. It can be used up to 10 to 5% in the diet of broilers and layer, respectively. If inclusion level is higher than 5% in layer diet, it may impart a fishy taint or off flavor to the egg yolk. This is due to the presence of choline ester sinapine which promotes the accumulation of trimethyl amine in the yolk. Inclusion of more than 10% RSM in the diet results in haemorrhagic fatty liver. Choline supplementation at 0.1% in broiler diets containing RSM was found to be beneficial during starter phase.

Anti-nutritional factors/limitations to use

Rapeseed contains several anti-nutritional factors like glucosinolates, tannins, erucic acid, sinapine, phytic acid, mucilage etc. The solvent extraction process reduces goitrogenic effect and removes most of erucic acid from the meal.

Inclusion in diet (%) (Maximum)

Chick	Broiler	Layer
3-10	5-10	8

Nutrient composition (90% Dry matter basis)

Proximate		Amino Acid	Digestible, %	Mineral	%
ME (kcal/kg)	1770	Lysine	1.62	Ca	0.63
CP (%)	34.00	Meth +Cys	1.41	AP	0.39
CP Digestibility (%)	75.40	Arginine	2.03	Na	0.10
EE (%)	1.43	Tryptophan	0.39	Cl	0.11
Lin. acid (%)	-	Threonine	1.25	K	1.14
CF (%)	11.6	Leucine	2.19		
Choline (mg/kg)	-	Isoleucine	1.08		
		Valine	1.37		



Synonyms : Gingelly Meal, Til cake
Scientific name : *Sesamum indicum* L
Local names : Hindi : Til cake
Kannada : Ellu
Marathi : Til pend
Tamil : Ellu punnakku
Telugu : Nuvvula pindi

Annual production in India : 0.777 million tons (2017-18)

Major producing states : Andhra Pradesh, Gujarat, Karnataka, Tamilnadu, Madhya Pradesh, Maharashtra, West Bengal

Nutritive value

Sesame meal (SSM) contains about 36-40% protein. It is a rich source of methionine, cysteine and tryptophan, but is low in lysine and threonine. Therefore, it gives better quality protein when one part of the meal is mixed with 2 parts of SBM. The ME content in black til cake is higher than that of red variety. High sulfur amino acid and essential fatty acid content in sesame meal makes it popular in feeding to poultry.

Anti-nutritional factors/ Limitations to use

Sesame seeds contain high levels of oxalic acid (0.4%) and phytic acid (5%). The dark coloured varieties are higher in these anti-nutritional factors than red colored ones. Oxalic acid and phytate are known to interfere with mineral metabolism and decrease availability of calcium, phosphorus, magnesium, zinc and iron. Higher level of oxalic acid may also damage kidneys and reduce palatability of feed due to its bitter taste. Decortications of seeds may remove oxalates, but has little effect on phytates. Use of phytase enzyme and providing higher level of zinc may be beneficial when high levels of SSM is added in poultry diet.

Inclusion in diet (%) (Maximum)

Chick	Broiler	Layer
10	10	20

Nutrient composition (90% Dry matter basis)

Proximate		Amino Acid	Digestible, %	Mineral	%
ME (kcal/ kg)	2210	Lysine	0.64	Ca	0.21
CP (%)	30.00	Meth +Cys	1.19	AP	0.50
EE (%)	6.50	Arginine	2.47	Na	0.05
Lin. acid (%)	1.90	Tryptophan	0.32	Cl	0.05
CF (%)	6.20	Threonine	0.78	K	1.20
Choline (mg/kg)	1448	Leucine	1.57		
		Isoleucine	0.85		
		Valine	1.13		

Scientific name : *Gossypium spp*

Local names : Hindi : Kapas Kannada : Hatti
Marathi : Saraki pend Tamil : Paruthi kottai punnaku
Telugu : Patti ginjala pindi

Annual production in India: 4.488 million tons (2021)

Major producing states : Maharashtra, Gujarat, Andhra Pradesh, Telangana, Tamil Nadu, Karnataka, Rajasthan, Punjab, Madhya Pradesh, West Bengal

Nutritive value

Cottonseed meal (CSM) has a lower protein content and high fibre content than SBM. Undecorticated and decorticated CSM contains about 22 and 41% protein, respectively. Major portion of CSM available is with hulls (crude fibre) in India. The undecorticated expeller CSM may contain 1500-1800 kcal ME/kg while the decorticated solvent extracted CSM may contain 2000-2400 kcal ME/kg. Cotton seed meal is gaining acceptability because of improved processing methods. Gossypol present in the pigment glands of the seed and cyclopropanoid fatty acids limits its use. However from 2012 onwards, CSM is used layer diets in southern states of India without having any adverse effects on performance besides reducing cost of feed. Deoiled and decorticated CSM can be used upto 12% (maximum level tested) in layer chick and grower diets without affecting weight gain and feed conversion efficiency provided the free gossypol content is low. The glandless varieties of cotton seed virtually free of gossypol are available now a days.

Anti-nutritional factors/limitations to use

Gossypol present in the pigment glands of the seed and cyclopropanoid fatty acids limit CSM use in poultry diets. Gossypol can be in a bound form which is nontoxic to monogastric animals or in a free form which is toxic. The free form has inhibitory effects on digestive enzymes and also reduces palatability. Excess feeding of gossypol causes olive green yolks in stored eggs due to the chemical reaction between iron and gossypol. Cotton seed meal should not be used in the diet of male breeders. Ferrous sulphate may be supplemented to reduce toxic effect of gossypol. Cyclopropanoid fatty acids also cause pink discoloration of egg albumin. Presence of pesticide residues and aflatoxin /mycotoxin contamination are the major concerns to use the CSM in poultry diets.

Inclusion in diet (%) (Maximum)

Chick	Broiler	Layer
12	12	12

Nutrient composition (90% Dry matter basis)

Proximate		Amino Acid	Digestible, %	Mineral	%
ME (kcal/kg)	2100	Lysine	1.14	Ca	0.20
CP (%)	42.00	Meth +Cys	1.04	AP	0.28
CP Digestibility (%)	75.50	Arginine	3.96	Na	0.04
EE (%)	3.90	Tryptophan	0.43	Cl	0.04
Lin. acid (%)	2.47	Threonine	1.39	K	1.19
CF (%)	13.6	Leucine	1.87		
Choline (mg.kg)	2753	Isoleucine	1.01		
		Valine	1.44		



Synonyms : Coconut Meal

Scientific name : *Cocos nucifera*

Local names : Hindi : Nariyal Kannada : Cobberi hindi
 Malayalam : Kopparai Tamil : Thenghai punnakku
 Marathi : Naral Telugu : Kobbari pindi

Annual production in India : Coconut meal production: 0.264 million tons (2017-18)

Major producing states : Kerala, Tamilnadu, Karnataka, Andhra Pradesh, West Bengal, Odisha, Gujarat, Assam

Nutritive value

Coconut meal is produced after extraction of oil from dried coconut fruit. Oil may be extracted either through expeller or solvent extraction process. Coconut meal produced by expeller process has residual oil content of more than 8% and solvent process less than 2%. Coconut oil is composed predominantly of short chain saturated fatty acids that are easily digested by poultry. High oil containing CM may be good source of energy for poultry. Deoiled coconut meal is moderately low in protein (20-22% CP) and energy (1900 kcal ME/kg). The low ME content is due to its high fibre level (14% CF). The protein is of poor quality with poor amino acid balance and digestibility. It is deficient in essential amino acids such as lysine, methionine, threonine and histidine but high in arginine. Adequate lysine supplementation is necessary to correct deficiency and also arginine antagonism. Deoiled coconut cake can be used up to 5% in chick diet without affecting the performance. With adequate formulation (energy and amino acids) CM can be efficiently used up to 8% in laying hen diet.

Anti-nutritional factors/limitations to use

However, high moisture content and poor storage conditions may lead to mycotoxin contamination. High storage temperature also leads to oxidation of residual oil which in turn affects the palatability of the meal. The high fibre content limits the usage of copra meal in poultry. The fiber is also rich in mannans which have low digestibility and often have a laxative effect in poultry.

Inclusion in diet (%) (Maximum)

Chick	Broiler	Layer
5	5	8

Nutrient composition (90% Dry matter basis)

Proximate		Amino Acid	Digestible, %	Mineral	%
ME (kcal/kg)	1525	Lysine	0.50	Ca	0.17
CP (%)	19.20	Meth +Cys	0.58	NPP	0.22
CP Digestibility (%)	71.20	Arginine	1.97	Na	0.04
EE (%)	12.00	Tryptophan	0.12	Cl	0.03
Lin. acid (%)	-	Threonine	0.58	K	1.41
CF (%)	14.4	Leucine	1.18		
Choline (mg/kg)	1089	Isoleucine	0.63		
		Valine	0.91		



Scientific name : *Cyamopsis tetragonoloba*

Local names : Hindi : Guar

Kannada: Gori kai

Tamil : Kothaavarai punnakku

Telugu : Goru chikkudu pindi

Annual production in India: Not available

Major producing states : Rajasthan, Gujarat, Haryana, Punjab, Uttar Pradesh, Madhya Pradesh

Nutritive value

Guar belongs to legume family and is resistant to drought conditions. Guar is also known as cluster bean and it is extensively cultivated in India for extracting gum from the seed. Guar endosperm containing mannogalactan is used in paper production, the fabric industry, food products and medicines. The endosperm contains the gum which is extracted from seeds during dry milling by mechanical separators. After extraction of gummy endosperm the remaining testa and the embryo is called guar meal (GM). Thus GM is a byproduct of gum extraction and contains both hulls (75%) and germ (25%). It has a ME value of 2300 kcal/kg. It is a good source of protein with an amino acid composition quite similar to that of ground nut meal.

Anti-nutritional factors/limitations to use

The antinutritional factors present are residual gum, trypsin inhibitor, hydrogen cyanide and haemagglutinins. The meal is high in molybdenum, which may interfere with copper metabolism. Trypsin inhibitors can be inactivated by proper heat treatment. Higher level of GM in diet causes diarrhoea, depressed growth rate and increased mortality in broilers and decreased egg production and feed efficiency in layers. Supplementation of β -mannanase to feed containing GM reduces viscosity and reduces the deleterious effects associated with feeding of GM.

Inclusion in diet (%) (Maximum)

Chick	Broiler	Layer
3	3	5

Nutrient composition (90% Dry matter basis)

Proximate		Amino Acid	Digestible, %	Mineral	%
ME (kcal/kg)	2250	Lysine	1.65	Ca	0.50
CP (%)	46.50	Meth +Cys	1.20	NPP	0.20
EE (%)	5.00	Arginine	6.02	Na	-
Lin. acid (%)	2.50	Tryptophan	0.40	Cl	-
CF (%)	10.50	Threonine	1.34	K	-
Choline (mg/kg)	-	Leucine	2.58		
		Isoleucine	1.41		
		Valine	1.65		

Dried Distillery Grains with Solubles from Rice



Annual production in India : 0.9 million tons

Major producing states : Uttar Pradesh, Maharashtra, Karnataka, Tamilnadu, Bihar, Andhra Pradesh, Punjab and Telangana

Nutritive value

Rice based dried distillery grains with solubles (DDGS) is a byproduct from the distillery industry. It is the product obtained after removal of ethyl alcohol by distillation from the yeast fermentation of rice grain. It is a good source of crude protein and content varied from 38 to 57% with a mean value of 46.4%. Nutrient profile of rice DDGS is highly variable. The variation may be due to variation in the quality of raw material used and the process employed for alcohol production. DDGS is also prone for mycotoxin contamination, if DDGS after oil extraction is not dried immediately and stored improperly. Adequate drying, cooling and storage of DDGS is important to avoid mycotoxin contamination. Experiments conducted at DPR indicated that DDGS can be incorporated at 10% in broiler and layer diets without affecting performance and feed intake.

Anti-nutritional factors/limitations to use

Nutrient variation, high sulphur and copper content of DDGS, handling issues and possibility of mycotoxin contamination limit its use in poultry diet.

Inclusion in diet (%) (Maximum)

Chick	Broiler	Layer
10	10	10

Nutrient composition (90% Dry matter basis)

Proximate		Amino Acid	Digestible, %	Mineral	%
ME (kcal/kg)	2650	Arginine	3.332	Calcium	0.30
CP (%)	45.00	Lysine	1.331	NPP	0.28
CP Digestibility (%)	70.00	Methionine	0.56	K	1.98
EE (%)	-	Cystine	0.30	Cl	0.01
Linoleic acid (%)	-	Threonine	1.140	Na	0.05
CF (%)	-	Tryptophan	0.678		
Ash (%)	-				



Local names : Hindi : Machili Kannada : Meenu hindi
Marathi : Machhi Tamil : Karuvadu
Telugu : Chepa podi

Annual production in India: 0.9 million tons

Major producing states : Gujarat, Kerala, Tamilnadu, Andhra Pradesh, West Bengal, Karnataka, Orissa and Maharashtra

Nutritive value

Fish meal is manufactured from clean, dried and ground tissues of undecomposed whole fish with or without extraction of oil and containing less than 3% common salt. Fish meal is an excellent source of protein (varies from 40 to 60%) having the majority of limiting amino acids like lysine, methionine and threonine. It is also rich in available phosphorus, calcium, iodine, selenium and vitamin B12. Feeding value of fish meal depend on the kind of fish used and method of manufacture. Good quality fish meal is brown colored and dark color indicative of overheating. Overheating affects the protein quality. Good quality fish meal can be added upto maximum of 10% in broilers and 5% in layers. It is advisable to use only good quality fish meal.

Anti-nutritional factors/limitations to use

Variation in protein content, poor protein quality due to overheating, contamination with pathogenic bacteria due to improper processing and storage conditions, adulteration with non-protein nitrogen compounds, sand, salt and oil, etc. are the limitations with fish meal. Higher level of addition may also lead to fishy taint in meat and eggs and may also affect gizzard health in young birds.

Inclusion in diet (%) (Maximum)

Chick	Broiler	Layer
10	10	5

Nutrient composition (90% Dry matter basis)

Proximate		Amino Acid	Digestible, %	Mineral	%
ME (kcal/ kg)	2200	Lysine	2.71	Ca	7.00
CP (%)	43.00	Meth +Cys	1.38	AP	2.38
CP Digestibility (%)	86.7	Arginine	2.24	Na	2.00
EE (%)	2.00	Tryptophan	0.38	Cl	0.60
Lin. acid (%)	3.81	Threonine	1.60	K	0.13
CF (%)	0.9	Leucine	2.83		
Choline (mg/kg)	3056	Isoleucine	1.60		
		Valine	1.95		

Meat Cum Bone Meal



Major producing states : Kerala, Telangana, Andhra Pradesh, West Bengal, Tamilnadu and Maharashtra

Nutritive value

Meat cum bone meal is produced from whole carcass of animals which are unfit for human consumption. Skin, hooves and horns are not used for production of the meal. It contains 44- 60 % protein and is a good source of calcium and phosphorus. Nutritional quality is highly variable.

Anti-nutritional factors/limitations to use

Variation in nutritional quality due to the variation in gelatin content, adulteration with sand, rock phosphate, contamination with pathogenic bacteria limits its usage. The meal has to be adequately sterilized to make it pathogen free and retain higher amino acid digestibility.

Inclusion in diet (%) (Maximum)

Chick	Broiler	Layer
5	5	5

Nutrient composition (90% Dry matter basis)

Proximate		Amino Acid	Digestible, %	Mineral	%
ME (kcal/kg)	2800	Lysine	1.96	Ca	7.50
CP (%)	45.00	Meth +Cys	0.83	NPP	3.80
CP Digestibility (%)	78.40	Arginine	2.76	Na	0.70
EE (%)	2.00	Tryptophan	0.23	Cl	0.69
Lin. acid (%)	0.40	Threonine	1.23	K	0.60
CF (%)	2.6	Leucine	2.18		
Choline (mg/kg)	1996	Isoleucine	1.01		
		Valine	1.56		

Silkworm Pupae Meal



Local names: Assamee : Khandbahale Hindi : Reshamee ka keeda
Kannada : Reshmu hulu Marathi : Reshmi keeda
Tamil : PattuPulu punnakku Telugu : Pattupurugula cake

Annual production in India:Data not available

Major producing states : Karnataka, Andhra Pradesh, West Bengal, Tamilnadu and Maharashtra

Nutritive value

Large quantities of silk worm pupae are available after the silk thread is removed from the silk cocoon. A good quality silkworm pupae meal (SWPM) contains 50-65% crude protein. Keeping quality can be improved by removing the oil. The SWPM protein is rich in lysine, methionine, isoleucine, tryptophan and low in threonine. Deoiled SWPM can be added at the level of 2-3% in poultry diet.

Anti-nutritional factors/ limitations to use

Variation in nutritional quality, low threonine, low digestibility, rancidity in high oil meals and contamination with pathogenic bacteria limits its usage.

Inclusion in diet (%) (Maximum)

Chick	Broiler	Layer
2	2	3

Nutrient composition (90% Dry matter basis)

Proximate		Amino Acid	Digestible, %	Mineral	%
ME (kcal/ kg)	2400	Lysine	4.34	Ca	0.29
CP (%)	60.00	Meth +Cys	3.40	NPP	0.58
EE (%)	6.00	Arginine	4.13	Na	0.06
Lin. acid (%)	1.90	Tryptophan	0.75	Cl	-
CF (%)	3.5	Threonine		K	0.97
Choline (mg/kg)		Leucine	1.40		
		Isoleucine	2.37		
		Valine			

Minerals are the inorganic elements which are not synthesized in the body and hence should be included in diet. Based on the requirements, they are divided in to two categories such as major or macro minerals which are expressed as percentage of diets and minor or trace minerals which are expressed as milligrams per kg of diet. Minerals are required for the formation of skeletal system, for general health as components of general metabolic activity and / or maintenance of acid- base balance. Calcium and phosphorus are necessary for the formation and maintenance of skeleton and also for good egg shell quality. Dietary sodium, potassium and chlorine play an important role in maintaining acid-base balance and for maintaining the physiological pH. Trace minerals such as iron, copper, manganese, zinc, selenium and iodine function as component of large molecules and cofactors of enzymes in various metabolic reactions. These minerals are required in minute quantities in the diets. While formulating the diets, all major and trace minerals should be supplemented in the diets.

The minerals are usually supplemented through either mineral mixture or specific mineral supplements. Several trace mineral mixtures are available commercially. Generally specific mineral supplements are added like stone grit, oyster shell or marble chips as a source of calcium. The popular phosphorus supplements are di calcium phosphate or mono calcium phosphate in poultry diets.

Table 5. Trace mineral content from different mineral supplements

Compound	Mineral	Content (%)
Copper sulphate mono hydrate	Copper	35
Copper sulphate penta hydrate	Copper	25
Cupric carbonate	Copper	53
Cupric oxide	Copper	75
Copper chloride	Copper	37
Ferrous carbonate	Iron	43
Ferrous sulphate	Iron	21
Ferrous oxide	Iron	77
Potassium iodide	Iodine	76
Potassium iodate	Iodine	59
Calcium iodate	Iodine	65
Manganous carbonate	Manganese	47
Manganous sulphate mono hydrate	Manganese	25
Manganous sulphate penta hydrate	Manganese	22
Manganous oxide	Manganese	77
Manganous chloride	Manganese	27.5
Zinc sulphate	Zinc	22
Zinc oxide	Zinc	73
Zinc chloride	Zinc	48
Zinc carbonate	Zinc	52
Sodium selenite	Selenium	45
Sodium selenate	Selenium	41

Table 6. Nutrient composition of mineral sources

Nutrient	Common salt	Sodium bicarbonate	DCP	LSP	Stone grit
Calcium (%)	Nil	Nil	21.00	32.00	30.00
Avail Phos (%)	Nil	Nil	17.00	Nil	Nil
Sodium (%)	39.70	27.38	Nil	Nil	Nil
Chloride (%)	60.30	Nil	Nil	Nil	Nil

DCP-Dicalcium phosphate, LSP-limestone powder

Table 7. Composition (g/kg) of trace mineral premix

Trace mineral	Grams
Iron	50
Copper	20
Manganese	100
Zinc	100
Iodine	2.5
Selenium	0.15

Vitamins are a group of organic compounds which are essential in very small quantities. Vitamins are essential for normal body functions, growth and reproduction. A deficiency of one or more vitamins can lead to a number of diseases or syndromes.

Vitamins are in two categories: fat-soluble and water-soluble. The fat-soluble vitamins are A, D, E, and K. Vitamin A is required for normal growth and development of epithelial tissue (skin and the linings of the digestive, reproductive, and respiratory tracts) and reproduction. Vitamin D3 is required for normal growth, bone development, and eggshell formation. Vitamin K is essential for blood clot formation. Vitamin E is a potent anti-oxidant and also helps in immune stimulation.

The water-soluble vitamins include vitamin C and the B vitamins. The B vitamins include vitamin B12, biotin, folacin, niacin, pantothenic acid, pyridoxine, riboflavin, and thiamin. The B vitamins are involved in energy metabolism. Because of the simple digestive tract and rapid rate of digesta passage there is little intestinal synthesis of B complex vitamins in Poultry. Under normal conditions, adult chicken can synthesize vitamin C. However under stressed conditions the vitamin C synthesis is not adequate and must be supplemented through diet. A vitamin premix is used to compensate for the fluctuating levels of vitamins found naturally in feed ingredients and to assure adequate intake of all vitamins.

Vitamins are supplemented either through premixes or through individual vitamins. The vitamin content in commonly available synthetic vitamin sources is given in table.

Vitamin	Per g
Vitamin A, IU	500000
Vitamin D3, IU	200000
Vitamin D3, IU	600000
Vitamin E,50%, mg	500

Two types of vitamin premixes are available in the market. One premix supplies vitamins A, D3, and K and riboflavin (B2). The inclusion rate is 50 to 150 g per ton depending upon concentration. The other premix supplies water-soluble vitamins including members of B-complex, and sometimes vitamin C. The rate of inclusion is 75-250 g per ton of feed depending upon concentration of different vitamins. In addition, choline chloride (100, 60 or 50% premix) is also available in the market. A complete vitamin premix having fat soluble and B complex vitamins are available with 500g /ton mixing dose. Separate vitamin premixes of layers, broilers and breeders are available.

Table 8. Composition (units/kg) of vitamin premix

It is recommended to add vitamin premix @ 500g/Ton of feed.

Vitamins	Units	Quantity
Vitamin A	MIU	25
Vitamin D3	MICU	5.6
Vitamin E	g	60
Vitamin K3	g	4
Vitamin B1	g	4
Vitamin B2	g	10
Vitamin B6	g	6
Vitamin B12	g	0.03
Biotin	g	0.16
Pantothenic acid	g	30
Folic Acid	g	2
Niacin	g	80

Any intentionally added ingredient in small quantities (0.05%) not normally consumed as feed by itself, whether or not it has a nutritive value, which affect the characteristics of feed or animal products is called as feed additives.

The production performance of birds has improved in last few years due to many factors like improvement in genetic potential of the birds, overall improvement in other inputs provided in the diet. Broilers are growing faster and layers are producing eggs at higher rate than ever before. Such birds require adequate and precise nutrition. Even after fulfilling nutrient requirements as per the prescribed standards, availability of nutrients to the extent required is sometimes difficult. Therefore, the use of appropriate feed additives in poultry diet has become obligatory. These feed additives improve physical appearance, consistency, nutritive quality, shelf life, sometimes nutrient availability and texture of diets. Thus, feed additives are important, through non-nutritive in nature, to help in improving growth, egg production, feed efficiency, immune responses, health status, yolk colour etc...

Nutritive feed additives

Vitamins, trace minerals and amino acids are essential nutrients. However, the practical feed ingredients sometimes are not able to provide the adequate quantity in the feed. This is because of the differences in their availability and increased requirement of birds. Hence, it is needed to supplement vitamins, trace minerals and amino acids in practical chicken diets. These are available either in pure form or diluted with specific concentration as premix.

Non-nutritive feed additives

They include prebiotics, probiotics, acidifiers and pH optimizers, antioxidants, feed enzymes, toxin binders, herbal products, antibiotic growth promoters, anticoccidials, emulsifiers, flavours, and carotenoids, immune modulators etc.

Prebiotics

Prebiotics are nondigestible feed ingredients. Non digestible carbohydrates, some peptides and proteins, and certain lipids are prebiotics. The non-digestible oligosaccharides improve the performance and gut health of poultry by preventing the pathogenic bacteria adhering to gut wall and by reaching the hindgut of the bird in an undigested form by influencing hindgut fermentation towards growth of more desirable bacteria. Hindgut fermentation of prebiotics leads to release of short chain fatty acids which reduce pathogenic bacteria and improve beneficial microbes like lactobacillus.

The substance does not only affect the non-immunogenic defense mechanism in the gastro- intestinal tract, but also functions by modulating the immunogenic protection mechanism

Probiotics

The probiotics are live microbial feed supplements that benefit the host by establishing a favorable intestinal microbial balance and maintaining proper gut health. They are nonpathogenic to the birds as well as human beings.

The probiotics are live microbial feed supplements that benefit the host by establishing a favorable intestinal microbial balance and maintaining proper gut health. They are nonpathogenic to the birds as well as human beings.

They act by following ways:

- Adherence to intestinal mucosa thereby preventing attachment of pathogens
- Competition with pathogens for adhesion site in the gut and nutrients
- Stimulation of the intestinal immune response
- Increase nutrient digestibility
- Affecting the permeability of gut and increasing the uptake of nutrients
- Enhancing the host immune system

The commonly used probiotics are Lactobacilli (*L. acidophilus*, *L. sporogenes*), *Saccharomyces* (*S. cerevisiae*, *S. Boulardii*), *Streptococcus* (*S. lactis*, *S. thermophilus*), *Bacillus* (*B. cereus*, *B. subtilis*), Bifido bacterium.

Acidifiers and pH Optimizers

The pH of the gastric and intestinal tract directly affects the activity of various digestive enzymes and rate of digestion of feedstuff. Additionally, the pH effects the species composition of intestinal micro flora and prevalence of potential pathogens. pH of gastro-intestinal tract affects ability of pathogens to colonize the gut. Neutral pH may favor the growth of *E. coli* and salmonella. Lower pH values are more conducive to the growth of beneficial bacteria.

Acidifiers are more useful in young chicks as they are effective against disease causing microbes in the gut and are relatively inexpensive. A feed additive composed of primary organic acids with volatile fatty acids derivatives can reduce pH around the pathogenic bacteria causing a bacteriostatic effect. Simultaneously, such product can provide a bactericidal effect by supplying low molecular weight acid molecules that can penetrate bacterial cell.

Commonly used acidifiers are formic acid, butyric acid, lauric acid and acetic acid.

Antioxidants

Feed Antioxidants

High fat containing ingredients like fishmeal, meat meal, poultry by-products and vegetable oil and oil products are the common ingredients of poultry feed. All these ingredients are highly prone to the auto-oxidative rancidity, which has adverse effects on palatability of feed and bio-availability of nutrients. This process may destroy critical nutrients like vitamin A, D, E and biotin and ultimately has a serious negative effect on growth performance and production. Antioxidant in turn helps in preserving the nutritive value and freshness of diet. It maintains potency of dietary energy and critical vitamins and natural pigments. Commonly used antioxidants are Butylated Hydroxyl Anisole (BHA) and Ethoxyquin, etc. singly or in the commercially available combinations. Dose is needed

Systemic antioxidants

Under normal or stressful conditions, reactive oxygen species (ROS) like OH, O, peroxide, superoxide etc, etc. are released during regular metabolism. The production of ROS will be very high during stress condition like variation in the ambient temperature, humidity, medication, vaccination, bird shifting, beak trimming, overcrowding and disease outbreak. Excessively produced ROS will damage the lipid membranes of all vital organs leads to production drop, immune break down, disease occurrence and severe economic loss. Majority of trace minerals like Se, Zn, Fe, Cu and Cr and vitamin E and C are potent natural anti-oxidants, which are reported to reduce the ill effects of oxidative stress in chicken.

Enzymes

Most of plant feed ingredients contain anti-nutritional factors like non-starch polysaccharides (NSP's) and phytate. Poultry do not have enzyme system to utilize effectively these NSPs and phytates. The feed enzymes are protein in nature, catalysts, augmenting host enzyme system, and they are target specific. Supplementing feed enzymes to poultry feed reduces negative effect of NSPs and phytates, thereby improve feed digestibility, nutrient availability, and performance. Enzymes act by reducing gut viscosity, increasing digestibility and nutrient absorption and reducing pathogenic populations in the hind gut. Some enzymes (epoxidase, enolase, epoxidase, catalase, etc..) also hydrolyse the mycotoxins.

Toxin binders

Different clay or natural adsorbents are used to reduce the toxic effects of fungal and chemical toxins in poultry diets. Several substances like activated charcoal, alumino-silicates, bentonites, silicon and zeolites, glucomannan etc., have been found beneficial in minimizing the toxic effect of feed mycotoxins. Hydrated sodium calcium alumino-silicate (HSCAS) has strong effect on toxin binding. Oils rich in PUFA are also potent adsorbants of fungal toxins.

Herbal supplements

Parts of many plants such as bark, fruit, seed, leaf, flower, etc. and their extracts are used for treating the diseases and ailments in man, animals and birds. These natural products are safe and eco-friendly. Many products like growth stimulators, liver tonics, anti-stress factors, coccidiostats and immune-modulators are prepared from plants. The essential oils have antimicrobial activity are also promising and used in poultry feed.

Coccidiostats

Coccidiosis is a disease of economic importance caused by Eimeria group of protozoa. Ionophores and chemical compounds are regularly used in the feed to keep the coccidiosis away resulting into economic improvement of the flock. Commonly used ionophores are salinomycin, narasin, maduramycin, lasalocid, monensin and chemical compounds such as diclazuril, amprolium, nicarbazine, D.O.T., robenidine, etc.

Emulsifiers

Young birds are not capable of digesting fat present in feed. They can utilize the fat efficiently, provided, emulsifiers along with antioxidants are added in the feed. Products containing lyso-phospholipids, sodium oleate, sodium dodecyl sulfate, polyethelene glycerate, polyethelene sorbitate, can aid in nutrient uptake from the digestive tract. Addition of such products may in turn improve growth and feed conversion.

Carotenoids

Carotenoids are recently gaining importance in the field of poultry nutrition because of their growth promoting and immune stimulating effect. They also stimulate phagocytic and bacteria killing ability of neutrophils and potential macrophages. Carotenoids are also used in colouring of yolk in egg and pigmentation of meat and legs. There are both synthetic and natural colouring agents.

Immunomodulators

Immunomodulators are substances which modulate the activity of immune system. Immune response in poultry is influenced by genetic background, nutrition, environment and management or any combination of the above. The aims of immune modulating substances are to induce effective and sustained immune response from both innate and acquired immunity. Integrity of the immune system is vital to safeguard from various infectious diseases. Important nutrients involved in host defense mechanism include energy, critical amino acids (Arginine, lysine and methionine), certain vitamins (A, E, D, C and B6), minerals (selenium, zinc, copper, iron), prebiotics, probiotics etc...

Flavoring agents

Flavoring agents are feed additives that are supposed to increase palatability and feed intake. There is need for flavoring agents that will help to keep up feed intake

- a) When highly unpalatable medicants are being mixed in the feed.
- b) During outbreak of diseases,
- c) When animals are under stress, and

When less palatable feedstuffs are fed either as such or being incorporated in the ration

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Feed Formulation for Broilers and Layers





Table 9. Broiler feed formulae (kg/ton)

Ingredient	Age, days	No Enzyme			With enzymes		
		1-14	15-28	29-42	1-14	15-28	29-42
Maize		546.1	584.1	645.3	632.5	672.5	732.4
Oil-Veg		37.26	38.75	34.91	4.25	5.04	1.64
Soybean meal 45%		366.1	333.0	278.6	317.7	284.2	230.1
Salt		3.43	3.44	3.20	3.43	3.44	3.45
Sodium bi-carbonate		1.50	1.50	1.50	1.50	1.50	1.50
Dicalcium Phosphate		18.95	16.28	15.55	11.84	9.17	8.44
LSP-Powder		14.58	15.10	13.00	15.02	15.55	13.43
DL-Methionine		3.48	2.21	1.89	3.25	1.98	1.66
L-Lysine Hcl		2.52	0.90	1.30	2.85	1.24	1.64
L-Threonine		0.85	0.00	0.00	0.77	0.00	0.00
L-Tryptophan		0.00	0.00	0.00	0.09	0.00	0.00
L Arginine		0.49	0.00	0.00	1.69	0.31	0.67
Choline Chloride,75%		1.00	1.00	1.00	1.00	1.00	1.00
Toxin Binder		1.00	1.00	1.00	1.00	1.00	1.00
Vitamin Premix		0.50	0.50	0.50	0.50	0.50	0.50
Trace Mineral Mixture		1.00	1.00	1.00	1.00	1.00	1.00
Coccidiostat		0.50	0.50	0.50	0.50	0.50	0.50
Liver Tonic		0.50	0.50	0.50	0.50	0.50	0.50
Vit E and Se		0.25	0.25	0.25	0.25	0.25	0.25
Enzyme		0.00	0.00	0.00	0.25	0.25	0.25
Phytase 5000		0.00	0.00	0.00	0.10	0.10	0.10





Table 10. Broiler feed formulae (kg/ton) with MBM

Ingredient	Age, days	No Enzyme			With enzymes		
		1-14	15-28	29-42	1-14	15-28	29-42
Maize		546.4	614.6	683.5	626.8	681.4	731.1
Oil-Veg		37.10	25.18	17.93	5.26	0.00	0.00
Soybean meal 45%		365.6	287.9	222.3	301.9	252.7	197.9
MBM-45%		0.47	40.00	50.00	30.00	40.00	50.00
Dicalcium Phosphate		18.85	7.80	4.95	5.38	0.61	0.00
LSP-Powder		14.55	11.75	8.81	12.40	12.11	7.60
Salt		3.42	2.75	2.33	2.91	2.75	2.59
Sodium bi-carbonate		1.50	1.50	1.50	1.50	1.50	1.50
Vitamin Premix		0.50	0.50	0.50	0.50	0.50	0.50
Trace Mineral Mixture		1.00	1.00	1.00	1.00	1.00	1.00
DL-Methionine		3.48	2.30	2.00	3.41	2.13	1.89
L-Lysine Hcl		2.52	1.36	1.87	3.09	1.61	2.06
L-Threonine		0.85	0.04	0.07	0.91	0.00	0.04
L-Tryptophan		0.00	0.00	0.00	0.11	0.00	0.06
L Arginine		0.49	0.00	0.00	1.35	0.12	0.25
Choline Chloride,75%		1.00	1.00	1.00	1.00	1.00	1.00
Toxin Binder		1.00	1.00	1.00	1.00	1.00	1.00
Coccidiostat		0.50	0.50	0.50	0.50	0.50	0.50
Liver Tonic		0.50	0.50	0.50	0.50	0.50	0.50
Vit E and Se		0.25	0.25	0.25	0.25	0.25	0.25
NSP Enzyme		0.00	0.00	0.00	0.15	0.18	0.12
Phytase 5000		0.00	0.00	0.00	0.10	0.10	0.10

MBM : Meat cum Bone Meal



Maize-SBM-DDGS Formulae



Table 11. Broiler feed formulae (kg/ton) with DDGS from rice

Ingredient	Age, days	No Enzyme			With enzymes		
		1-14	15-28	29-42	1-14	15-28	29-42
Maize		557.0	588.3	650.9	634.6	676.3	723.2
Oil-Veg		25.30	33.79	28.28	0.00	0.00	0.00
Soybean meal 45%		224.0	272.3	197.7	257.4	213.7	145.9
DDGS		140.0	60.0	80.0	60.0	70.0	90.0
Dicalcium Phosphate		18.51	16.09	15.30	11.66	8.95	8.14
LSP-Powder		15.06	15.31	13.27	16.43	16.09	17.12
Salt		3.46	3.45	3.22	3.45	3.46	3.47
Sodium bi-carbonate		1.50	1.50	1.50	1.50	1.50	1.50
Vitamin Premix		0.50	0.50	0.50	0.50	0.50	0.50
Trace Mineral Mixture		1.00	1.00	1.00	1.00	1.00	1.00
DL-Methionine		3.89	2.38	2.12	3.43	2.18	1.95
L-Lysine Hcl		5.00	1.96	2.71	3.90	2.47	3.16
L-Threonine		1.50	0.18	0.28	1.05	0.15	0.25
L-Tryptophan		0.00	0.00	0.00	0.03	0.00	0.00
L Arginine		0.09	0.00	0.00	1.51	0.10	0.24
Choline Chloride,75%		1.00	1.00	1.00	1.00	1.00	1.00
Toxin Binder		1.00	1.00	1.00	1.00	1.00	1.00
Coccidiostat		0.50	0.50	0.50	0.50	0.50	0.50
Liver Tonic		0.50	0.50	0.50	0.50	0.50	0.50
Vit E and Se		0.25	0.25	0.25	0.25	0.25	0.25
NSP Enzyme		0.00	0.00	0.00	0.25	0.25	0.22
Phytase 5000		0.00	0.00	0.00	0.10	0.10	0.10

DDGS : Distillery Dried Grain with Solubles





Table 12. Layer feed formulae (kg/ton)

Ingredient	Age (weeks)				
	0-8	9-16	17-20	21-45	46-90
Maize	616.2	512.2	595.0	599.9	581.0
Soybean meal 45%	231.1	87.12	231.6	217.1	179.0
Deoiled Rice Bran	104.7	359.1	90.80	48.87	103.4
Dicalcium Phosphate	16.46	13.41	11.98	12.57	11.46
LSP-Powder	17.22	13.61	0.00	35.00	35.00
Stone Grit	0.00	0.00	54.90	75.81	80.15
Salt	3.12	2.97	3.65	2.94	2.91
Sodium bi-carbonate	1.50	1.50	1.50	1.50	1.50
Vitamin Premix	0.50	0.50	0.50	0.50	0.50
Trace Mineral Mixture	1.00	1.00	1.00	1.00	1.00
DL-Methionine	3.32	2.40	2.98	2.25	1.89
L-Lysine Hcl	0.93	2.40	0.45	0.00	0.00
L-Threonine	0.52	0.69	0.29	0.00	0.00
L-Tryptophan	0.17	0.38	0.09	0.00	0.00
Choline Chloride,75%	1.00	1.00	1.00	0.75	0.40
Toxin Binder	1.00	1.00	1.00	1.00	1.00
Coccidiostat	0.50	0.00	0.00	0.00	0.00
Liver Tonic	0.50	0.50	3.04	0.50	0.50
Vit E and Se	0.25	0.25	0.25	0.25	0.25





Table 13. Layer feed formulae (kg/ton) with Enzymes

Ingredient	Age (weeks)				
	0-8	9-16	17-20	21-45	46-90
Maize	559.8	457.0	534.6	544.2	525.1
Soybean meal 45%	155.9	12.7	152.2	142.6	103.7
Deoiled Rice Bran	244.4	496.3	243.4	187.4	242.5
Dicalcium Phosphate	7.52	4.48	2.99	3.64	2.53
LSP-Powder	17.77	14.15	25.00	35.00	35.00
Stone Grit	0.00	0.00	28.85	76.39	80.74
Salt	3.03	2.88	3.04	2.85	2.82
Sodium bi-carbonate	1.50	1.50	1.50	1.50	1.50
Vitamin Premix	0.50	0.50	0.50	0.50	0.50
Trace Mineral Mixture	1.00	1.00	1.00	1.00	1.00
DL-Methionine	2.86	1.95	2.50	1.80	1.44
L-Lysine Hcl	1.26	2.69	0.81	0.15	0.33
L-Threonine	0.44	0.61	0.20	0.00	0.00
L-Tryptophan	0.41	0.62	0.33	0.20	0.24
L Arginine	0.00	0.54	0.00	0.00	0.00
Choline Chloride,75%	1.00	1.00	1.00	0.75	0.50
Toxin Binder	1.00	1.00	1.00	1.00	1.00
Coccidiostat	0.50	0.00	0.00	0.00	0.00
Liver Tonic	0.50	0.50	0.50	0.50	0.50
Vit E and Se	0.25	0.25	0.25	0.25	0.25
Phytase 5000	0.12	0.12	0.12	0.12	0.12
NSP Enzyme	0.25	0.25	0.25	0.25	0.25



Maize-SBM-MBM Formulae



Table 14. Layer feed formulae (kg/ton) with MBM

Ingredient	Age (weeks)				
	0-8	9-16	17-20	21-45	46-90
Maize	596.1	492.1	563.4	573.1	554.2
Soybean meal 45%	189.6	45.73	171.6	162.7	123.9
MBM-45%	30.00	30.00	40.00	40.00	40.00
Deoiled Rice Bran	145.2	399.5	159.3	102.8	157.6
Dicalcium Phosphate	10.00	6.95	3.32	3.96	2.85
LSP-Powder	14.72	11.11	25.00	35.00	35.00
Stone Grit	0.00	0.00	24.72	72.26	76.60
Salt	2.58	2.42	2.41	2.21	2.18
Sodium bi-carbonate	1.50	1.50	1.50	1.50	1.50
Vitamin Premix	0.50	0.50	0.50	0.50	0.50
Trace Mineral Mixture	1.00	1.00	1.00	1.00	1.00
DL-Methionine	3.32	2.41	2.96	2.25	1.90
L-Lysine Hcl	1.28	2.71	0.95	0.19	0.45
L-Threonine	0.62	0.79	0.42	0.00	0.00
L-Tryptophan	0.29	0.50	0.25	0.12	0.15
Choline Chloride,75%	1.00	1.00	1.00	0.75	0.50
Toxin Binder	1.00	1.00	1.00	1.00	1.00
Coccidiostat	0.50	0.00	0.00	0.00	0.00
Liver Tonic	0.50	0.50	0.50	0.50	0.50
Vit E and Se	0.25	0.25	0.25	0.25	0.25

MBM : Meat cum Bone Meal



Maize-SBM-MBM Formulae



Table 15. Layer feed formulae (kg/ton) with MBM and Enzymes

Ingredient	Age (weeks)				
	0-8	9-16	17-20	21-45	46-90
Maize	533.4	454.9	508.7	518.7	506.1
Soybean meal 45%	101.0	7.85	98.04	88.93	63.40
MBM-45%	40.00	3.89	40.00	40.00	30.00
Deoiled Rice Bran	297.3	500.0	293.9	237.3	279.9
Dicalcium Phosphate	0.00	3.65	0.00	0.00	0.00
LSP-Powder	13.73	13.83	25.00	35.00	35.00
Stone Grit	0.00	0.00	21.37	69.36	75.33
Salt	2.31	3.31	2.32	2.13	2.28
Sodium bi-carbonate	1.50	1.50	1.50	1.50	1.50
Vitamin Premix	0.50	0.50	0.50	0.50	0.50
Trace Mineral Mixture	1.00	1.00	1.00	1.00	1.00
DL-Methionine	2.87	1.96	2.52	1.81	1.45
L-Lysine Hcl	1.72	2.73	1.26	0.52	0.66
L-Threonine	0.57	0.62	0.33	0.00	0.00
L-Tryptophan	0.57	0.64	0.48	0.36	0.35
L Arginine	0.00	0.55	0.00	0.00	0.00
Choline Chloride,75%	1.00	1.00	1.00	0.75	0.50
Toxin Binder	1.00	1.00	1.00	1.00	1.00
Coccidiostat	0.50	0.00	0.00	0.00	0.00
Liver Tonic	0.50	0.50	0.50	0.50	0.50
Vit E and Se	0.25	0.25	0.25	0.25	0.25
Phytase 5000	0.12	0.12	0.12	0.12	0.12
NSP Enzyme	0.25	0.25	0.25	0.25	0.25

MBM : Meat cum Bone Meal



Maize-SBM-DDGS Formulae



Table 16. Layer feed formulae (kg/ton) with Rice DDGS

Ingredient	Age (weeks)				
	0-8	9-16	17-20	21-45	46-90
Maize	599.0	493.3	548.4	589.0	555.8
Soybean meal 45%	165.9	15.60	67.61	151.2	83.09
DDGS	60.79	66.80	148.7	70.00	90.00
Deoiled Rice Bran	124.9	381.2	153.9	45.8	132.7
Dicalcium Phosphate	16.22	13.14	11.34	12.40	11.10
LSP-Powder	17.43	13.85	25.00	35.00	35.00
Stone Grit	0.00	0.00	28.83	83.89	80.49
Salt	3.12	2.97	3.14	3.72	2.91
Sodium bi-carbonate	1.50	1.50	1.50	1.50	1.50
Vitamin Premix	0.50	0.50	0.50	0.50	0.50
Trace Mineral Mixture	1.00	1.00	1.00	1.00	1.00
DL-Methionine	3.46	2.56	3.31	2.48	2.10
L-Lysine Hcl	2.00	3.54	3.10	0.90	1.56
L-Threonine	0.80	1.00	0.97	0.15	0.09
L-Tryptophan	0.12	0.32	0.00	0.00	0.00
Choline Chloride,75%	1.00	1.00	1.00	0.75	0.40
Toxin Binder	1.00	1.00	1.00	1.00	1.00
Coccidiostat	0.50	0.00	0.00	0.00	0.00
Liver Tonic	0.50	0.50	0.50	0.50	0.50
Vit E and Se	0.25	0.25	0.25	0.25	0.25

DDGS : Distillers Dried Grains and Solubles



Maize-SBM-DDGS Formulae



Table 17. Layer feed formulae (kg/ton) with Rice DDGS and enzymes

Ingredient	Age (weeks)				
	0-8	9-16	17-20	21-45	46-90
Maize	552.3	476.4	497.8	524.5	499.9
Soybean meal 45%	102.8	0.00	12.53	68.31	8.33
Deoiled Rice Bran	241.5	429.2	286.5	210.0	271.5
DDGS	62.20	60.00	130.3	70.00	90.00
Dicalcium Phosphate	7.28	4.24	2.48	3.35	2.16
LSP-Powder	17.92	14.12	25.00	35.00	35.00
Stone Grit	0.00	0.00	29.34	76.66	81.07
Salt	3.05	2.93	3.05	2.85	2.82
Sodium bi-carbonate	1.50	1.50	1.50	1.50	1.50
Vitamin Premix	0.50	0.50	0.50	0.50	0.50
Trace Mineral Mixture	1.00	1.00	1.00	1.00	1.00
DL-Methionine	3.09	2.40	2.81	1.96	1.65
L-Lysine Hcl	2.30	3.55	3.10	1.29	1.88
L-Threonine	0.74	0.95	0.80	0.05	0.00
L-Tryptophan	0.31	0.39	0.20	0.13	0.15
Choline Chloride,75%	1.00	1.00	1.00	0.75	0.40
Toxin Binder	1.00	1.00	1.00	1.00	1.00
Coccidiostat	0.50	0.00	0.00	0.00	0.00
Liver Tonic	0.50	0.50	0.50	0.50	0.50
Vit E and Se	0.25	0.25	0.25	0.25	0.25
Phytase 5000	0.12	0.12	0.12	0.12	0.12
NSP Enzyme	0.20	0.06	0.25	0.25	0.25

DDGS : Distillers Dried Grains and Solubles



Table 18. Broiler feed formulae (kg/ton)

Ingredient	Age, days	No Enzyme			With enzymes		
		1-14	15-28	29-42	1-14	15-28	29-42
Maize		371.4	331.5	392.7	582.5	420.4	492.4
Rice Broken		100.0	100.0	100.0	0.00	100.0	100.0
Sorghum		8.43	80.00	80.00	0.00	80.00	80.00
Oil-Veg		53.57	60.28	56.42	13.90	26.37	20.30
Soybean meal 45%		285.5	253.3	198.9	247.1	204.5	171.9
Til cake / Sesame Meal		65.00	65.00	65.00	45.60	65.00	50.00
Cotton Seed Meal 42%		65.00	65.00	65.00	65.00	65.00	50.00
Dicalcium Phosphate		17.33	14.59	13.86	10.62	7.48	7.09
LSP-Powder		15.52	16.03	13.93	15.90	16.47	14.10
Salt		3.17	3.02	2.78	3.36	3.02	2.80
Sodium bi-carbonate		1.50	1.50	1.50	1.50	1.50	1.50
Vitamin Premix		0.50	0.50	0.50	0.50	0.50	0.50
Trace Mineral Mixture		1.00	1.00	1.00	1.00	1.00	1.00
DL-Methionine		3.29	2.11	1.79	3.23	1.88	1.61
L-Lysine Hcl		4.33	2.65	3.07	4.48	2.99	2.97
L-Threonine		1.22	0.30	0.31	1.00	0.22	0.17
L-Tryptophan		0.00	0.00	0.00	0.16	0.00	0.00
L Arginine		0.00	0.00	0.00	0.58	0.00	0.00
Choline Chloride,75%		1.00	1.00	1.00	1.00	1.00	1.00
Toxin Binder		1.00	1.00	1.00	1.00	1.00	1.00
Coccidiostat		0.50	0.50	0.50	0.50	0.50	0.50
Liver Tonic		0.50	0.50	0.50	0.50	0.50	0.50
Vit E and Se		0.25	0.25	0.25	0.25	0.25	0.25
NSP Enzyme		0.00	0.00	0.00	0.25	0.25	0.25
Phytase 5000		0.00	0.00	0.00	0.10	0.10	0.10

Table 19. Layer feed formulae (kg/ton)

Ingredient	Age (weeks)				
	0-8	9-16	17-20	21-45	46-90
Maize	521.9	335.9	458.5	495.4	484.2
Oil-Veg	0.00	20.00	10.00	1.82	0.00
Rice Broken	100.0	100.0	100.0	100.0	100.0
Soybean meal 45%	185.9	53.86	195.6	167.1	129.2
Cotton Seed Meal 42%	50.00	35.00	50.00	50.00	50.00
Til cake / Sesame Meal	50.00	35.00	8.81	50.00	50.00
Deoiled Rice Bran	45.39	382.47	101.56	0.00	47.45
Dicalcium Phosphate	15.31	12.35	11.42	11.44	10.35
LSP-Powder	17.84	13.98	40.00	40.00	40.00
Stone Grit	0.00	0.00	12.42	71.15	75.49
Salt	2.94	2.75	2.95	2.75	2.72
Sodium bi-carbonate	1.50	1.50	1.50	1.50	1.50
Vitamin Premix	0.50	0.50	0.50	0.50	0.50
Trace Mineral Mixture	1.00	1.00	1.00	1.00	1.00
DL-Methionine	1.11	0.33	1.54	2.47	2.22
L-Lysine Hcl	3.29	2.16	1.00	1.32	1.71
L-Threonine	0.00	0.00	0.00	0.29	0.33
L-Tryptophan	0.00	0.00	0.00	0.03	0.09
Choline Chloride,75%	1.00	1.00	1.00	1.00	1.00
Toxin Binder	1.00	1.00	1.00	1.00	1.00
Coccidiostat	0.50	0.50	0.50	0.50	0.50
Liver Tonic	0.50	0.50	0.50	0.50	0.50
Vit E and Se	0.25	0.25	0.25	0.25	0.25



Table 20. Layer feed formulae (kg/ton) with Enzymes

Ingredient	Age (weeks)				
	0-8	9-16	17-20	21-45	46-90
Maize	465.7	299.4	398.6	453.2	429.6
Rice Broken	100.0	100.0	100.0	100.0	100.0
Sorghum	0.00	80.00	0.00	0.00	0.00
Soybean meal 45%	111.2	0.00	120.4	118.4	74.24
Cotton Seed Meal 42%	50.00	23.84	35.00	49.39	35.00
Til cake / Sesame Meal	50.00	50.00	35.00	0.00	35.00
Deoiled Rice Bran	184.6	416.9	233.5	151.8	195.5
Dicalcium Phosphate	6.37	3.35	2.05	3.44	1.74
LSP-Powder	18.39	14.60	40.00	40.00	40.00
Stone Grit	0.00	0.00	13.25	71.08	75.80
Salt	2.85	2.54	2.85	2.70	2.65
Sodium bi-carbonate	1.50	1.50	1.50	1.50	1.50
Vitamin Premix	0.50	0.50	0.50	0.50	0.50
Trace Mineral Mixture	1.00	1.00	1.00	1.00	1.00
DL-Methionine	0.65	0.03	0.99	2.18	1.80
L-Lysine Hcl	3.60	2.53	1.50	1.00	1.59
L-Threonine	0.00	0.00	0.00	0.05	0.18
L-Tryptophan	0.00	0.19	0.21	0.25	0.30
L Arginine	0.00	0.00	0.00	0.00	0.00
Choline Chloride,75%	1.00	1.00	1.00	1.00	1.00
Toxin Binder	1.00	1.00	1.00	1.00	1.00
Coccidiostat	0.50	0.50	0.50	0.50	0.50
Liver Tonic	0.50	0.50	0.50	0.50	0.50
Vit E and Se	0.25	0.25	0.25	0.25	0.25
NSP Enzyme	0.25	0.25	0.25	0.25	0.25
Phytase 5000	0.12	0.12	0.12	0.12	0.12



Table 21. Broiler feed formulae (kg/ton)

Ingredient	Age, days	No Enzyme			With enzymes		
		1-14	15-28	29-42	1-14	15-28	29-42
Maize		294.3	328.9	390.1	422.1	417.7	479.1
Rice Broken		100.0	100.0	100.0	100.0	100.0	100.0
Sorghum		80.00	80.00	80.00	41.27	80.00	80.00
Oil-Veg		61.13	63.77	59.92	25.56	30.06	26.00
Soybean meal 45%		312.5	282.7	228.3	266.2	233.9	179.5
Cotton Seed Meal 42%		50.00	50.00	50.00	50.00	50.00	50.00
Sunflower meal		50.00	50.00	50.00	50.00	50.00	50.00
Dicalcium Phosphate		18.65	15.95	15.22	11.55	8.84	8.11
LSP-Powder		14.62	15.13	13.02	15.06	15.57	13.46
Salt		2.84	2.85	2.61	2.93	2.85	2.61
Sodium bi-carbonate		1.50	1.50	1.50	1.50	1.50	1.50
Vitamin Premix		0.50	0.50	0.50	0.50	0.50	0.50
Trace Mineral Mixture		1.00	1.00	1.00	1.00	1.00	1.00
DL-Methionine		3.56	2.24	1.92	3.28	2.01	1.69
L-Lysine Hcl		5.00	2.11	2.53	4.13	2.45	2.87
L-Threonine		1.15	0.13	0.14	1.00	0.04	0.06
L-Tryptophan		0.00	0.00	0.00	0.05	0.00	0.00
L Arginine		0.00	0.00	0.00	0.32	0.00	0.00
Choline Chloride,75%		1.00	1.00	1.00	1.00	1.00	1.00
Toxin Binder		1.00	1.00	1.00	1.00	1.00	1.00
Coccidiostat		0.50	0.50	0.50	0.50	0.50	0.50
Liver Tonic		0.50	0.50	0.50	0.50	0.50	0.50
Vit E and Se		0.25	0.25	0.25	0.25	0.25	0.25
Enzyme		0.00	0.00	0.00	0.25	0.25	0.25
Phytase 5000		0.00	0.00	0.00	0.10	0.10	0.10

Table 22. Layer feed formulae (kg/ton)

Ingredient	Age (weeks)				
	0-8	9-16	17-20	21-45	46-90
Maize	533.7	343.4	463.8	510.8	494.9
Oil-Veg	0.00	20.00	10.00	0.00	0.00
Rice Broken	100.0	100.0	100.0	100.0	100.0
Soybean meal 45%	200.5	61.83	186.8	189.3	140.9
Cotton Seed Meal 42%	50.00	35.00	50.00	50.00	50.00
Sunflower meal	50.00	35.00	50.00	14.44	50.00
Deoiled Rice Bran	20.10	366.71	63.34	0.00	24.94
Dicalcium Phosphate	16.37	13.10	11.75	12.42	11.43
LSP-Powder	17.19	13.53	40.00	40.00	40.00
Stone Grit	0.00	0.00	12.27	70.49	74.81
Salt	2.77	2.62	2.75	2.72	2.55
Sodium bi-carbonate	1.50	1.50	1.50	1.50	1.50
Vitamin Premix	0.50	0.50	0.50	0.50	0.50
Trace Mineral Mixture	1.00	1.00	1.00	1.00	1.00
DL-Methionine	1.21	0.41	1.53	2.62	2.34
L-Lysine Hcl	1.98	2.10	1.53	0.84	1.61
L-Threonine	0.00	0.00	0.00	0.15	0.22
L-Tryptophan	0.00	0.00	0.00	0.00	0.05
Choline Chloride,75%	1.00	1.00	1.00	1.00	1.00
Toxin Binder	1.00	1.00	1.00	1.00	1.00
Coccidiostat	0.50	0.50	0.50	0.50	0.50
Liver Tonic	0.50	0.50	0.50	0.50	0.50
Vit E and Se	0.25	0.25	0.25	0.25	0.25



Table 23. Layer feed formulae (kg/ton) with Enzymes

Ingredient	Age (weeks)				
	0-8	9-16	17-20	21-45	46-90
Maize	477.4	332.3	406.1	392.4	437.1
Rice Broken	100.0	100.0	100.0	100.0	100.0
Sorghum	0.00	47.81	0.00	80.00	0.00
Soybean meal 45%	125.8	0.00	128.4	113.3	82.41
Cotton Seed Meal 42%	50.00	50.00	35.00	50.00	35.00
Sunflower meal	50.00	0.00	35.00	34.28	35.00
Deoiled Rice Bran	159.23	439.6	217.9	102.4	179.8
Dicalcium Phosphate	7.43	4.20	2.81	3.52	2.49
LSP-Powder	17.74	14.14	40.00	40.00	40.00
Stone Grit	0.00	0.00	12.77	71.05	75.32
Salt	2.68	2.63	2.73	2.39	2.53
Sodium bi-carbonate	1.50	1.50	1.50	1.50	1.50
Vitamin Premix	0.50	0.50	0.50	0.50	0.50
Trace Mineral Mixture	1.00	1.00	1.00	1.00	1.00
DL-Methionine	0.75	0.17	1.08	2.23	1.88
L-Lysine Hcl	2.30	2.34	1.45	1.40	1.52
L-Threonine	0.00	0.00	0.00	0.14	0.11
L-Tryptophan	0.00	0.21	0.18	0.21	0.27
L Arginine	0.00	0.00	0.00	0.00	0.00
Choline Chloride,75%	1.00	1.00	1.00	1.00	1.00
Toxin Binder	1.00	1.00	1.00	1.00	1.00
Coccidiostat	0.50	0.50	0.50	0.50	0.50
Liver Tonic	0.50	0.50	0.50	0.50	0.50
Vit E and Se	0.25	0.25	0.25	0.25	0.25
NSP Enzyme	0.25	0.25	0.25	0.25	0.25
Phytase 5000	0.12	0.12	0.12	0.12	0.12

Table 24. Broiler feed formulae (kg/ton)

Ingredient	Age, days	No Enzyme			With enzymes		
		1-14	15-28	29-42	1-14	15-28	29-42
Maize		196.6	279.8	341.1	547.9	368.8	430.0
Rice Broken		0.00	100.0	100.0	0.00	100.0	100.0
Sorghum		0.00	50.00	50.00	0.00	50.00	50.00
Bajra		300.0	0.00	0.00	0.00	0.00	0.00
Ragi		50.00	50.00	50.00	0.00	50.00	50.00
Oil-Veg		0.00	69.93	66.07	22.22	36.01	32.15
Soybean meal 45%		333.6	291.4	237.0	279.5	242.6	188.2
Til cake / Sesame Meal		20.23	65.00	65.00	55.29	65.00	65.00
Sunflower meal		50.00	50.00	50.00	50.00	50.00	50.00
Dicalcium Phosphate		17.97	14.86	14.13	10.72	7.75	7.02
LSP-Powder		14.68	15.60	13.49	15.63	16.04	13.93
Salt		2.90	2.85	2.61	3.15	2.85	2.61
Sodium bi-carbonate		1.50	1.50	1.50	1.50	1.50	1.50
Vitamin Premix		0.50	0.50	0.50	0.50	0.50	0.50
Trace Mineral Mixture		1.00	1.00	1.00	1.00	1.00	1.00
DL-Methionine		3.01	1.94	1.62	3.05	1.70	1.39
L-Lysine Hcl		3.56	2.09	2.51	4.04	2.43	2.85
L-Threonine		1.00	0.27	0.28	1.00	0.19	0.20
L-Tryptophan		0.00	0.00	0.00	0.07	0.00	0.00
L Arginine		0.20	0.00	0.00	0.83	0.00	0.00
Choline Chloride,75%		1.00	1.00	1.00	1.00	1.00	1.00
Toxin Binder		1.00	1.00	1.00	1.00	1.00	1.00
Coccidiostat		0.50	0.50	0.50	0.50	0.50	0.50
Liver Tonic		0.50	0.50	0.50	0.50	0.50	0.50
Vit E and Se		0.25	0.25	0.25	0.25	0.25	0.25
NSP Enzyme		0.00	0.00	0.00	0.25	0.25	0.25
Phytase 5000		0.00	0.00	0.00	0.10	0.10	0.10



Table 25. Layer feed formulae (kg/ton)

Ingredient	Age, days	Age (Weeks)				
		0-8	9-16	17-20	21-45	46-72
Maize		420.0	344.6	417.4	495.3	494.7
Rice Broken		100.0	100.0	100.0	0.00	0.00
Sorghum		50.00	50.00	50.00	50.00	50.00
Ragi		50.00	50.00	50.00	50.00	50.00
Oil-Veg		6.55	0.00	0.00	0.00	0.00
Soybean meal 45%		213.8	93.71	217.5	174.4	152.7
Til cake / Sesame Meal		65.00	45.00	65.00	65.00	65.00
Sunflower meal		50.00	25.00	25.74	50.00	50.00
Deoiled Rice Bran		0.00	254.10	0.00	0.00	0.00
Dicalcium Phosphate		15.25	12.54	10.70	11.22	10.34
LSP-Powder		17.64	13.78	51.94	40.00	40.00
Stone Grit		0.00	0.00	0.00	51.30	74.16
Salt		2.60	2.57	2.72	2.53	2.54
Sodium bi-carbonate		1.50	1.50	1.50	1.50	1.50
Vitamin Premix		0.50	0.50	0.50	0.50	0.50
Trace Mineral Mixture		1.00	1.00	1.00	1.00	1.00
DL-Methionine		0.98	0.43	1.42	2.28	2.15
L-Lysine Hcl		1.97	2.01	1.28	1.47	1.71
L-Threonine		0.00	0.00	0.00	0.78	0.88
L-Tryptophan		0.00	0.00	0.00	0.00	0.02
Choline Chloride,75%		1.00	1.00	1.00	1.00	1.00
Toxin Binder		1.00	1.00	1.00	1.00	1.00
Coccidiostat		0.50	0.50	0.50	0.00	0.00
Liver Tonic		0.50	0.50	0.50	0.50	0.50
Vit E and Se		0.25	0.25	0.25	0.25	0.25



Table 26. Layer feed formulae (kg/ton) with Enzymes

Ingredient	Age, days	Age (Weeks)				
		0-8	9-16	17-20	21-45	46-90
Maize		171.4	288.6	363.5	308.6	232.8
Rice Broken		100.0	100.0	100.0	100.0	100.0
Sorghum		50.00	50.00	50.00	50.00	50.00
Bajra		297.0	0.00	0.00	80.00	15 6.6
Ragi		50.00	50.00	50.00	50.00	50.00
Soybean meal 45%		179.4	18.70	136.4	127.5	96.20
Til cake / Sesame Meal		65.00	45.00	65.00	65.00	65.00
Sunflower meal		50.00	25.00	50.00	50.00	50.00
Deoiled Rice Bran		0.00	393.2	118.8	42.72	66.63
Dicalcium Phosphate		7.78	3.60	1.85	2.51	1.43
LSP-Powder		17.72	14.33	52.48	40.00	40.00
Stone Grit		0.00	0.00	0.00	71.43	78.99
Salt		2.38	2.49	2.53	2.30	2.23
Sodium bi-carbonate		1.50	1.50	1.50	1.50	1.50
Vitamin Premix		0.50	0.50	0.50	0.50	0.50
Trace Mineral Mixture		1.00	1.00	1.00	1.00	1.00
DL-Methionine		0.52	0.00	0.95	1.91	1.64
L-Lysine Hcl		2.17	2.34	1.87	1.54	1.88
L-Threonine		0.00	0.00	0.00	0.30	0.35
L-Tryptophan		0.00	0.14	0.12	0.10	0.10
Choline Chloride,75%		1.00	1.00	1.00	1.00	1.00
Toxin Binder		1.00	1.00	1.00	1.00	1.00
Coccidiostat		0.50	0.50	0.50	0.00	0.00
Liver Tonic		0.50	0.50	0.50	0.50	0.50
Vit E and Se		0.25	0.25	0.25	0.25	0.25
NSP Enzyme		0.19	0.25	0.25	0.25	0.25
Phytase 5000		0.10	0.12	0.12	0.12	0.12

Table 27. Broiler feed formulae (kg/ton)

Ingredient	Age, days	No Enzyme			With enzymes		
		1-14	15-28	29-42	1-14	15-28	29-42
Maize		0.00	372.9	434.1	423.9	461.8	523.1
Rice Broken		100.0	100.0	100.0	100.0	100.0	100.0
Jowar		50.00	50.00	50.00	50.00	50.00	50.00
Bajra		131.9	0.00	0.00	0.00	0.00	0.00
Ragi		50.00	50.00	50.00	50.00	50.00	50.00
Tapioca Chips		148.3	0.00	0.00	0.00	0.00	0.00
Oil-Veg		74.06	48.50	44.64	13.12	14.58	10.73
Soya DOC 45%		296.8	234.1	179.7	217.8	185.3	130.8
Ground nut DOC		60.00	60.00	60.00	60.00	60.00	60.00
Silk Worm Pupae		40.00	40.00	40.00	40.00	40.00	40.00
Dicalcium Phosphate		18.52	15.63	14.90	11.19	8.51	7.79
LSP-Powder		13.30	15.33	13.22	15.25	15.77	13.66
Salt		2.95	3.02	2.78	3.02	3.02	2.78
Sodium bi-carbonate		1.50	1.50	1.50	1.50	1.50	1.50
Vitamin Premix		0.50	0.50	0.50	0.50	0.50	0.50
Trace Mineral Mixture		1.00	1.00	1.00	1.00	1.00	1.00
DL-Methionine		3.14	1.66	1.34	2.72	1.42	1.11
L-Lysine Hcl		2.50	1.47	1.88	3.50	1.81	2.23
L-Threonine		2.31	1.24	1.25	2.14	1.16	1.17
L-Tryptophan		0.00	0.00	0.00	0.14	0.00	0.04
L Arginine		0.00	0.00	0.00	0.62	0.00	0.00
Choline Chloride,75%		1.00	1.00	1.00	1.00	1.00	1.00
Toxin Binder		1.00	1.00	1.00	1.00	1.00	1.00
Coccidiostat		0.50	0.50	0.50	0.50	0.50	0.50
Liver Tonic		0.50	0.50	0.50	0.50	0.50	0.50
Vit E and Se		0.25	0.25	0.25	0.25	0.25	0.25
NSP Enzyme		0.00	0.00	0.00	0.25	0.25	0.25
Phytase 5000		0.00	0.00	0.00	0.10	0.10	0.10

Table 28. Layer feed formulae (kg/ton)

Ingredient	Age, days	Age (Weeks)				
		0-8	9-16	17-20	21-45	46-90
Maize		281.3	347.4	421.8	516.8	388.8
Rice Broken		100.0	100.0	100.0	0.000	100.0
Sorghum		50.00	50.00	50.00	50.00	50.00
Bajra		215.1	0.00	0.000	0.000	27.96
Ragi		50.00	50.00	50.00	50.00	50.00
Soybean meal 45%		159.2	64.06	138.8	139.7	86.89
Groundnut meal		60.00	30.00	60.00	60.00	60.00
Silk Worm Pupae		40.00	20.00	40.00	27.05	40.000
Deoiled Rice Bran		0.000	301.1	64.65	20.86	58.021
Dicalcium Phosphate		15.805	13.04	11.33	12.252	10.915
LSP-Powder		17.156	13.512	51.698	40.000	40.000
Stone Grit		0.000	0.000	0.000	70.661	75.008
Salt		2.613	2.641	2.739	2.703	2.500
Sodium bi-carbonate		1.500	1.500	1.500	1.500	1.500
Vitamin Premix		0.500	0.500	0.500	0.500	0.500
Trace Mineral Mixture		1.000	1.000	1.000	1.000	1.000
DL-Methionine		0.496	0.260	0.982	2.264	1.719
L-Lysine Hcl		1.281	1.508	0.883	0.786	0.971
L-Threonine		0.892	0.179	0.812	1.000	1.391
L-Tryptophan		0.000	0.000	0.020	0.093	0.100
Choline Chloride,75%		1.000	1.000	1.000	1.000	1.000
Toxin Binder		1.000	1.000	1.000	1.000	1.000
Coccidiostat		0.500	0.500	0.500	0.000	0.000
Liver Tonic		0.500	0.500	0.500	0.500	0.500
Vit E and Se		0.250	0.250	0.250	0.250	0.250



Table 29. Layer feed formulae (kg/ton) with Enzymes

Ingredient	Age, days	Age (Weeks)				
		0-8	9-16	17-20	21-45	46-90
Maize		59.85	291.9	366.0	270.3	206.4
Rice Broken		100.0	100.0	100.0	100.0	100.0
Sorghum		50.00	50.00	50.00	50.00	50.00
Bajra		300.0	0.00	0.00	135.3	193.9
Ragi		50.00	50.00	50.00	50.00	50.00
Tapioca Chips		150.0	0.00	0.00	0.00	0.00
Soybean meal 45%		154.9	0.00	63.87	101.0	72.34
Groundnut meal		60.00	18.90	60.00	17.77	11.17
Silk Worm Pupae		40.00	20.00	40.00	40.00	40.00
Deoiled Rice Bran		0.00	440.0	203.5	110.6	148.0
Dicalcium Phosphate		7.41	4.05	2.40	2.85	1.70
LSP-Powder		16.06	14.09	52.25	40.00	40.00
Stone Grit		0.00	0.00	0.00	71.23	75.52
Salt		2.84	2.57	2.65	2.44	2.38
Sodium bi-carbonate		1.50	1.50	1.50	1.50	1.50
Vitamin Premix		0.50	0.50	0.50	0.50	0.50
Trace Mineral Mixture		1.00	1.00	1.00	1.00	1.00
DL-Methionine		0.57	0.00	0.53	1.34	1.03
L-Lysine Hcl		0.89	1.63	1.21	0.05	0.29
L-Threonine		0.92	0.03	0.73	1.00	1.00
L-Tryptophan		0.00	0.17	0.26	0.10	0.10
Choline Chloride,75%		1.00	1.00	1.00	1.00	1.00
Toxin Binder		1.00	1.00	1.00	1.00	1.00
Coccidiostat		0.50	0.50	0.50	0.00	0.00
Liver Tonic		0.50	0.50	0.50	0.50	0.50
Vit E and Se		0.25	0.25	0.25	0.25	0.25
Enzyme		0.17	0.25	0.25	0.25	0.25
Phytase 5000		0.12	0.12	0.12	0.12	0.12



Table 30. Broiler feed formulae (kg/ton)

Ingredient	Age, days	No Enzyme			With enzymes		
		1-14	15-28	29-42	1-14	15-28	29-42
Maize		380.5	313.2	374.5	364.2	402.2	463.5
Rice Broken		0.00	100.0	100.0	100.0	100.0	100.0
Tapioca Chips		100.0	100.0	100.0	100.0	100.0	100.0
Oil-Veg		54.83	60.07	56.21	25.30	26.15	22.31
Soybean meal 45%		323.5	258.0	203.6	276.5	209.2	154.6
Coconut Cake		40.00	40.00	40.00	40.00	40.00	40.00
Fish Meal 45 %		50.00	50.00	50.00	50.00	50.00	50.00
Groundnut meal		16.97	50.00	50.00	15.50	50.00	50.00
Dicalcium Phosphate		12.53	10.00	9.27	5.41	2.89	2.17
LSP-Powder		7.37	7.63	5.52	7.64	8.07	5.97
Salt		0.90	0.72	0.48	0.76	0.72	0.48
Sodium bi-carbonate		1.50	1.50	1.50	1.50	1.50	1.50
Vitamin Premix		0.50	0.50	0.50	0.50	0.50	0.50
Trace Mineral Mixture		1.00	1.00	1.00	1.00	1.00	1.00
DL-Methionine		3.66	2.45	2.13	3.41	2.22	1.90
L-Lysine Hcl		2.43	1.34	1.75	2.69	1.68	2.10
L-Threonine		1.00	0.31	0.33	1.00	0.23	0.25
L-Tryptophan		0.00	0.00	0.00	0.13	0.01	0.12
L Arginine		0.00	0.00	0.00	0.83	0.00	0.00
Choline Chloride,75%		1.00	1.00	1.00	1.00	1.00	1.00
Toxin Binder		1.00	1.00	1.00	1.00	1.00	1.00
Coccidiostat		0.50	0.50	0.50	0.50	0.50	0.50
Liver Tonic		0.50	0.50	0.50	0.50	0.50	0.50
Vit E and Se		0.25	0.25	0.25	0.25	0.25	0.25
NSP Enzyme		0.00	0.00	0.00	0.25	0.25	0.25
Phytase 5000		0.00	0.00	0.00	0.10	0.10	0.10



Table 31. Layer feed formulae (kg/ton)

Ingredient	Age, days	Age (Weeks)				
		0-8	9-16	17-20	21-45	46-90
Maize		346.7	332.8	403.2	410.9	393.5
Rice Broken		100.0	100.0	100.0	100.0	100.0
Tapioca Chips		100.0	100.0	100.0	100.0	100.0
Oil-Veg		21.85	0.00	0.00	0.00	0.00
Soybean meal 45%		162.4	68.16	170.4	161.0	145.6
Deoiled Rice Bran		100.0	300.0	67.41	14.78	68.25
Coconut Cake		40.00	4.06	0.00	0.00	0.00
Fish Meal 45 %		50.00	40.00	50.00	50.00	50.00
Groundnut meal		50.00	30.00	50.00	44.87	21.50
Dicalcium Phosphate		10.14	8.58	5.90	6.57	5.35
LSP-Powder		9.72	7.34	43.97	40.00	40.00
Stone Grit		0.00	0.00	0.00	62.47	66.87
Salt		0.41	0.83	0.46	0.27	0.27
Sodium bi-carbonate		1.50	1.50	1.50	1.50	1.50
Vitamin Premix		0.50	0.50	0.50	0.50	0.50
Trace Mineral Mixture		1.00	1.00	1.00	1.00	1.00
DL-Methionine		1.33	0.72	1.76	2.75	2.42
L-Lysine Hcl		1.18	1.25	0.61	0.21	0.13
L-Threonine		0.00	0.00	0.00	0.35	0.24
L-Tryptophan		0.00	0.03	0.07	0.10	0.10
Choline Chloride,75%		1.00	1.00	1.00	1.00	1.00
Toxin Binder		1.00	1.00	1.00	1.00	1.00
Coccidiostat		0.50	0.50	0.50	0.00	0.00
Liver Tonic		0.50	0.50	0.50	0.50	0.50
Vit E and Se		0.25	0.25	0.25	0.25	0.25



Table 32. Layer feed formulae (kg/ton) with NSP Enzymes

Ingredient	Age (Weeks)				
	0-8	9-16	17-20	21-45	46-90
Maize	384.9	330.0	346.9	355.5	345.0
Rice Broken	100.0	100.0	100.0	100.0	100.0
Tapioca Chips	100.0	100.0	100.0	100.0	100.0
Soybean meal 45%	103.9	57.79	91.04	81.49	42.79
Deoiled Rice Bran	150.0	300.0	207.9	151.7	156.8
Coconut Cake	40.00	20.00	0.00	0.00	40.00
Fish Meal 45 %	50.00	40.00	50.00	50.00	50.00
Groundnut meal	50.00	30.00	50.00	50.00	50.00
Dicalcium Phosphate	1.43	0.00	0.00	0.00	0.00
LSP-Powder	10.23	0.00	42.57	40.00	40.00
Stone Grit	0.00	7.86	0.00	61.40	64.93
Salt	0.38	1.07	0.37	0.18	0.16
Sodium bi-carbonate	1.50	1.50	1.50	1.50	1.50
Vitamin Premix	0.50	0.50	0.50	0.50	0.50
Trace Mineral Mixture	1.00	1.20	1.00	1.00	1.00
DL-Methionine	1.02	0.69	1.35	2.32	2.15
L-Lysine Hcl	1.53	1.38	2.92	0.63	1.19
L-Threonine	0.00	0.00	0.00	0.30	0.39
L-Tryptophan	0.05	0.07	0.33	0.35	0.44
Choline Chloride,75%	1.00	1.00	1.00	1.00	1.00
Toxin Binder	1.00	1.00	1.00	1.00	1.00
Coccidiostat	0.50	0.50	0.50	0.00	0.00
Liver Tonic	0.50	5.00	0.50	0.50	0.50
Vit E and Se	0.25	0.25	0.25	0.25	0.25
Enzyme	0.25	0.03	0.25	0.25	0.25
Phytase 5000	0.12	0.12	0.12	0.12	0.12

Table 33. Broiler feed formulae (kg/ton)

Ingredient	Age, days	No Enzyme			With enzymes		
		1-14	15-28	29-42	1-14	15-28	29-42
Maize		504.5	441.0	502.2	489.5	530.0	591.3
Rice Broken		0.00	100.0	100.0	100.0	100.0	100.0
Oil-Veg		47.41	50.63	46.78	16.67	16.73	12.89
Soybean meal 45%		292.4	212.3	158.0	197.9	163.5	108.8
Groundnut meal		14.79	60.00	60.00	60.00	60.00	60.00
Cotton Seed Meal 42%		60.00	60.00	60.00	60.00	60.00	60.00
Rapeseed meal		30.00	30.00	30.00	30.00	30.00	30.00
Dicalcium Phosphate		18.33	15.93	15.20	11.43	8.82	8.09
LSP-Powder		14.68	14.87	12.76	14.84	15.31	13.20
Salt		3.32	3.12	2.88	3.11	3.12	2.88
Sodium bi-carbonate		1.50	1.50	1.50	1.50	1.50	1.50
Vitamin Premix		0.50	0.50	0.50	0.50	0.50	0.50
Trace Mineral Mixture		1.00	1.00	1.00	1.00	1.00	1.00
DL-Methionine		3.51	2.39	2.07	3.40	2.15	1.84
L-Lysine Hcl		3.82	3.09	3.49	5.01	3.42	3.84
L-Threonine		1.00	0.42	0.44	1.30	0.34	0.36
L-Tryptophan		0.00	0.00	0.00	0.25	0.05	0.16
Choline Chloride,75%		1.00	1.00	1.00	1.00	1.00	1.00
Toxin Binder		1.00	1.00	1.00	1.00	1.00	1.00
Coccidiostat		0.50	0.50	0.50	0.50	0.50	0.50
Liver Tonic		0.50	0.50	0.50	0.50	0.50	0.50
Vit E and Se		0.25	0.25	0.25	0.25	0.25	0.25
NSP Enzyme		0.00	0.00	0.00	0.25	0.25	0.25
Phytase 5000		0.00	0.00	0.00	0.10	0.10	0.10



Table 34. Broiler feed formulae (kg/ton)

Ingredient	Age, days	No Enzyme			With enzymes		
		1-14	15-28	29-42	1-14	15-28	29-42
Maize		535.8	471.2	535.3	519.8	560.3	624.5
Rice Broken		0.00	100.0	100.0	100.0	100.0	100.0
Oil-Veg		35.88	40.02	35.46	6.28	6.12	1.58
Soybean meal 45%		244.8	188.6	147.2	197.9	139.6	97.99
Fish Meal 45 %		50.00	50.00	50.00	50.00	50.00	50.00
Groundnut meal		27.73	50.00	45.00	25.91	50.00	45.00
Rapeseed meal		20.00	20.00	15.00	20.00	20.00	15.00
Cotton Seed Meal 42%		50.00	50.00	45.00	50.00	50.00	45.00
Dicalcium Phosphate		12.13	9.59	8.90	5.00	2.48	1.79
LSP-Powder		8.44	8.69	6.60	8.70	9.13	7.04
Salt		0.83	0.65	0.43	0.68	0.66	0.44
Sodium bi-carbonate		1.50	1.50	1.50	1.50	1.50	1.50
Vitamin Premix		0.50	0.50	0.50	0.50	0.50	0.50
Trace Mineral Mixture		1.00	1.00	1.00	1.00	1.00	1.00
DL-Methionine		3.40	2.18	1.86	3.14	1.95	1.64
L-Lysine Hcl		3.78	2.54	2.75	4.04	2.89	3.10
L-Threonine		1.00	0.26	0.24	1.00	0.19	0.17
L-Tryptophan		0.04	0.00	0.00	0.24	0.10	0.19
L Arginine		0.00	0.00	0.00	0.71	0.00	0.00
Choline Chloride,75%		1.00	1.00	1.00	1.00	1.00	1.00
Toxin Binder		1.00	1.00	1.00	1.00	1.00	1.00
Coccidiostat		0.50	0.50	0.50	0.50	0.50	0.50
Liver Tonic		0.50	0.50	0.50	0.50	0.50	0.50
Vit E and Se		0.25	0.25	0.25	0.25	0.25	0.25
NSP Enzyme		0.00	0.00	0.00	0.25	0.25	0.25
Phytase 5000		0.00	0.00	0.00	0.10	0.10	0.10



Table 35. Layer feed formulae (kg/ton)

Ingredient	Age (Weeks)				
	0-8	9-16	17-20	21-45	46-90
Maize	474.4	423.6	499.0	507.2	489.7
Rice Broken	100.0	100.0	100.0	100.0	100.0
Oil-Veg	12.44	0.00	0.00	0.00	0.00
Soybean meal 45%	116.9	55.41	152.6	122.7	134.1
Deoiled Rice Bran	100.0	312.8	62.55	4.04	62.97
Cotton Seed Meal 42%	60.00	20.00	45.00	50.00	40.00
Rapeseed meal	30.00	20.00	20.00	30.00	20.00
Groundnut meal	60.00	30.00	45.00	50.00	14.96
Dicalcium Phosphate	16.06	13.20	11.72	12.34	11.18
LSP-Powder	16.96	13.23	51.25	40.00	40.00
Stone Grit	0.00	0.00	0.00	70.17	74.61
Salt	2.80	2.75	2.88	2.66	2.70
Sodium bi-carbonate	1.50	1.50	1.50	1.50	1.50
Vitamin Premix	0.50	0.50	0.50	0.50	0.50
Trace Mineral Mixture	1.00	1.00	1.00	1.00	1.00
DL-Methionine	1.26	0.58	1.70	2.70	2.35
L-Lysine Hcl	2.91	2.18	1.90	1.84	1.31
L-Threonine	0.06	0.00	0.00	0.47	0.27
L-Tryptophan	0.00	0.04	0.08	0.14	0.10
Choline Chloride,75%	1.00	1.00	1.00	1.00	1.00
Toxin Binder	1.00	1.00	1.00	1.00	1.00
Coccidiostat	0.50	0.50	0.50	0.00	0.00
Liver Tonic	0.50	0.50	0.50	0.50	0.50
Vit E and Se	0.25	0.25	0.25	0.25	0.25



Table 36. Layer feed formulae (kg/ton) with Enzymes

Ingredient	Age (Weeks)				
	0-8	9-16	17-20	21-45	46-90
Maize	459.9	369.0	443.2	449.4	432.3
Rice Broken	100.0	100.0	100.0	100.0	100.0
Oil-Veg	2.62	0.00	0.00	0.00	0.00
Soybean meal 45%	49.19	0.00	77.47	90.69	33.59
Deoiled Rice Bran	200.0	450.9	201.5	153.0	203.0
Cotton Seed Meal 42%	60.00	20.00	45.00	0.00	40.00
Rapeseed meal	30.00	20.00	20.00	30.00	20.00
Groundnut meal	60.00	10.34	45.00	50.00	40.00
Dicalcium Phosphate	7.22	4.18	2.79	3.55	2.37
LSP-Powder	17.49	13.83	51.80	40.00	40.00
Stone Grit	0.00	0.00	0.00	70.46	75.13
Salt	2.74	2.69	2.79	2.60	2.58
Sodium bi-carbonate	1.50	1.50	1.50	1.50	1.50
Vitamin Premix	0.50	0.50	0.50	0.50	0.50
Trace Mineral Mixture	1.00	1.00	1.00	1.00	1.00
DL-Methionine	0.87	0.07	1.25	2.20	1.97
L-Lysine Hcl	3.24	2.14	2.24	1.33	2.14
L-Threonine	0.00	0.00	0.00	0.33	0.34
L-Tryptophan	0.09	0.23	0.32	0.33	0.40
Choline Chloride,75%	1.00	1.00	1.00	1.00	1.00
Toxin Binder	1.00	1.00	1.00	1.00	1.00
Coccidiostat	0.50	0.50	0.50	0.00	0.00
Liver Tonic	0.50	0.50	0.50	0.50	0.50
Vit E and Se	0.25	0.25	0.25	0.25	0.25
NSP Enzyme	0.25	0.25	0.25	0.25	0.25
Phytase 5000	0.12	0.12	0.12	0.12	0.12



Table 37. Layer feed formulae (kg/ton)

Ingredient	Age (Weeks)				
	0-8	9-16	17-20	21-45	46-72
Maize	504.8	414.9	487.5	492.3	476.1
Rice Broken	100.0	100.0	100.0	100.0	100.0
Oil-Veg	1.89	0.00	0.00	0.00	0.00
Soybean meal 45%	108.3	21.36	116.6	87.68	75.51
Deoiled Rice Bran	100.0	334.8	92.77	45.41	97.31
Fish Meal 45 %	50.00	30.00	40.00	50.00	40.00
Cotton Seed Meal 42%	40.00	20.00	40.00	40.00	35.00
Rapeseed meal	25.00	20.00	20.00	25.00	15.00
Groundnut meal	40.00	30.00	40.00	40.00	35.00
Dicalcium Phosphate	9.66	9.29	6.50	5.84	6.12
LSP-Powder	10.72	9.52	46.29	40.00	40.00
Stone Grit	0.00	0.00	0.00	63.57	69.29
Salt	0.35	1.24	0.87	0.17	0.67
Sodium bi-carbonate	1.50	1.50	1.50	1.50	1.50
Vitamin Premix	0.50	0.50	0.50	0.50	0.50
Trace Mineral Mixture	1.00	1.00	1.00	1.00	1.00
DL-Methionine	1.01	0.43	1.47	2.41	2.21
L-Lysine Hcl	2.06	2.12	1.63	1.33	1.50
L-Threonine	0.00	0.00	0.00	0.31	0.32
L-Tryptophan	0.00	0.09	0.14	0.19	0.21
Choline Chloride,75%	1.00	1.00	1.00	1.00	1.00
Toxin Binder	1.00	1.00	1.00	1.00	1.00
Coccidiostat	0.50	0.50	0.50	0.00	0.00
Liver Tonic	0.50	0.50	0.50	0.50	0.50
Vit E and Se	0.25	0.25	0.25	0.25	0.25



Table 38. Layer feed formulae (kg/ton) with Enzymes

Ingredient	Age (Weeks)				
	0-8	9-16	17-20	21-45	46-90
Maize	437.1	359.5	432.5	437.5	421.2
Rice Broken	100.0	100.0	100.0	100.0	100.0
Soybean meal 45%	31.38	0.00	42.17	13.61	1.36
Deoiled Rice Bran	250.0	482.3	229.3	181.5	233.6
Fish Meal 45 %	50.00	30.00	40.00	50.00	40.00
Cotton Seed Meal 42%	40.00	3.37	40.00	40.00	35.00
Rapeseed meal	25.00	4.74	20.00	25.00	15.00
Groundnut meal	40.00	0.00	40.00	40.00	35.00
Dicalcium Phosphate	0.70	0.40	0.00	0.00	0.00
LSP-Powder	11.28	10.15	45.24	40.00	40.00
Stone Grit	0.00	0.00	0.00	61.99	67.90
Salt	0.25	1.22	0.79	0.08	0.58
Sodium bi-carbonate	1.50	1.50	1.50	1.50	1.50
Vitamin Premix	0.50	0.50	0.50	0.50	0.50
Trace Mineral Mixture	1.00	1.00	1.00	1.00	1.00
DL-Methionine	0.54	0.00	1.03	1.97	1.77
L-Lysine Hcl	2.38	1.51	1.96	1.65	1.83
L-Threonine	0.00	0.00	0.00	0.22	0.24
L-Tryptophan	0.11	0.23	0.37	0.43	0.45
Choline Chloride,75%	1.00	1.00	1.00	1.00	1.00
Toxin Binder	1.00	1.00	1.00	1.00	1.00
Coccidiostat	0.50	0.50	0.50	0.00	0.00
Liver Tonic	0.50	0.50	0.50	0.50	0.50
Vit E and Se	0.25	0.25	0.25	0.25	0.25
NSP Enzyme	0.25	0.25	0.25	0.25	0.25
Phytase 5000	0.12	0.12	0.12	0.12	0.12



Table 39. Broiler feed formulae (kg/ton)

Ingredient	Age, days	No Enzyme			With enzymes		
		1-14	15-28	29-42	1-14	15-28	29-42
Maize		219.4	260.1	321.3	458.9	349.1	410.3
Rice Broken		150.0	150.0	150.0	0.00	150.0	150.0
Wheat Broken		150.0	150.0	150.0	150.0	150.0	150.0
Oil-Veg		56.49	56.59	52.73	18.80	22.67	18.81
Soybean meal 45%		294.2	259.4	205.0	286.0	210.6	156.2
Rapeseed meal		30.00	30.00	30.00	30.00	30.00	30.00
Guar Meal		50.00	50.00	50.00	10.62	50.00	50.00
Dicalcium Phosphate		18.99	16.38	15.65	11.83	9.27	8.54
LSP-Powder		13.54	14.02	11.91	14.48	14.46	12.35
Salt		2.98	2.99	2.75	3.19	2.99	2.75
Sodium bi-carbonate		1.50	1.50	1.50	1.50	1.50	1.50
Vitamin Premix		0.50	0.50	0.50	0.50	0.50	0.50
Trace Mineral Mixture		1.00	1.00	1.00	1.00	1.00	1.00
DL-Methionine		3.34	2.10	1.78	3.16	1.86	1.55
L-Lysine Hcl		3.48	1.90	2.31	3.34	2.24	2.65
L-Threonine		1.32	0.37	0.39	1.00	0.29	0.31
L-Tryptophan		0.00	0.00	0.00	0.07	0.00	0.01
L Arginine		0.00	0.00	0.00	1.99	0.00	0.00
Choline Chloride,75%		1.00	1.00	1.00	1.00	1.00	1.00
Toxin Binder		1.00	1.00	1.00	1.00	1.00	1.00
Coccidiostat		0.50	0.50	0.50	0.50	0.50	0.50
Liver Tonic		0.50	0.50	0.50	0.50	0.50	0.50
Vit E and Se		0.25	0.25	0.25	0.25	0.25	0.25
NSP Enzyme		0.00	0.00	0.00	0.25	0.25	0.25
Phytase 5000		0.00	0.00	0.00	0.10	0.10	0.10



Table 40. Layer feed formulae (kg/ton)

Ingredient	Age (Weeks)				
	0-8	9-16	17-20	21-45	46-90
Maize	293.5	267.6	343.0	342.8	331.7
Rice Broken	150.0	150.0	150.0	150.0	150.0
Wheat Broken	150.0	150.0	150.0	150.0	150.0
Oil-Veg	18.39	0.00	0.00	0.00	0.00
Soybean meal 45%	163.9	52.66	186.4	147.6	122.5
Deoiled Rice Bran	100.0	282.0	36.31	3.57	37.82
Rapeseed meal	30.00	20.00	20.00	30.00	20.00
Guar Meal	50.00	40.00	40.00	50.00	50.00
Dicalcium Phosphate	16.52	13.71	12.24	12.76	11.85
LSP-Powder	16.11	12.58	50.50	40.00	40.00
Stone Grit	0.00	0.00	0.00	61.02	73.70
Salt	2.68	2.58	2.74	2.52	2.52
Sodium bi-carbonate	1.50	1.50	1.50	1.50	1.50
Vitamin Premix	0.50	0.50	0.50	0.50	0.50
Trace Mineral Mixture	1.00	1.00	1.00	1.00	1.00
DL-Methionine	0.98	0.46	1.51	2.43	2.25
L-Lysine Hcl	1.74	2.12	1.13	1.09	1.36
L-Threonine	0.01	0.00	0.00	0.48	0.53
L-Tryptophan	0.00	0.00	0.00	0.04	0.08
Choline Chloride,75%	1.00	1.00	1.00	1.00	1.00
Toxin Binder	1.00	1.00	1.00	1.00	1.00
Coccidiostat	0.50	0.50	0.50	0.00	0.00
Liver Tonic	0.50	0.50	0.50	0.50	0.50
Vit E and Se	0.25	0.25	0.25	0.25	0.25



Table 41. Layer feed formulae (kg/ton) with Enzymes

Ingredient	Age (Weeks)				
	0-8	9-16	17-20	21-45	46-90
Maize	279.0	225.2	287.1	295.2	275.9
Rice Broken	150.0	150.0	150.0	150.0	150.0
Wheat Broken	150.0	150.0	150.0	150.0	150.0
Oil-Veg	8.54	0.00	0.00	0.00	0.00
Soybean meal 45%	96.26	0.00	111.3	80.50	47.55
Guar Meal	50.00	40.00	40.00	50.00	50.00
Rapeseed meal	30.00	20.00	20.00	30.00	20.00
Deoiled Rice Bran	200.0	385.3	175.3	117.9	176.6
Dicalcium Phosphate	7.68	4.77	3.31	3.93	2.91
LSP-Powder	16.64	13.02	51.05	40.00	40.00
Stone Grit	0.00	0.00	0.00	69.87	74.28
Salt	2.61	2.51	2.65	2.45	2.44
Sodium bi-carbonate	1.50	1.50	1.50	1.50	1.50
Vitamin Premix	0.50	0.50	0.50	0.50	0.50
Trace Mineral Mixture	1.00	1.00	1.00	1.00	1.00
DL-Methionine	0.58	0.14	1.06	2.03	1.80
L-Lysine Hcl	2.07	2.37	1.46	1.36	1.69
L-Threonine	0.00	0.00	0.00	0.40	0.44
L-Tryptophan	0.00	0.14	0.20	0.27	0.32
Choline Chloride,75%	1.00	1.00	1.00	1.00	1.00
Toxin Binder	1.00	1.00	1.00	1.00	1.00
Coccidiostat	0.50	0.50	0.50	0.00	0.00
Liver Tonic	0.50	0.50	0.50	0.50	0.50
Vit E and Se	0.25	0.25	0.25	0.25	0.25
NSP Enzyme	0.25	0.16	0.25	0.25	0.25
Phytase 5000	0.12	0.12	0.12	0.12	0.12

Table 42. Broiler feed formulae (kg/ton)

Ingredient	Age, days	No Enzyme			With enzymes		
		1-14	15-28	29-42	1-14	15-28	29-42
Maize		354.7	239.9	301.1	350.3	328.9	390.1
Rice Broken		0.00	150.0	150.0	90.11	150.0	150.0
Bajra		150.0	150.0	150.0	150.0	150.0	150.0
Oil-Veg		54.49	60.17	56.31	23.93	26.25	22.40
Soybean meal 45%		312.4	277.0	222.6	262.9	228.2	173.8
Rapeseed meal		30.00	30.00	30.00	30.00	30.00	30.00
Guar Meal		49.10	50.00	50.00	50.00	50.00	50.00
Dicalcium Phosphate		18.43	15.80	15.07	11.30	8.69	7.96
LSP-Powder		13.93	14.13	12.03	14.21	14.58	12.47
Salt		3.28	3.06	2.82	3.15	3.06	2.82
Sodium bi-carbonate		1.50	1.50	1.50	1.50	1.50	1.50
Vitamin Premix		0.50	0.50	0.50	0.50	0.50	0.50
Trace Mineral Mixture		1.00	1.00	1.00	1.00	1.00	1.00
DL-Methionine		3.28	2.00	1.68	3.02	1.77	1.45
L-Lysine Hcl		3.17	1.52	1.94	3.48	1.86	2.28
L-Threonine		1.00	0.18	0.19	1.00	0.10	0.11
L-Tryptophan		0.00	0.00	0.00	0.03	0.00	0.00
Choline Chloride,75%		1.00	1.00	1.00	1.00	1.00	1.00
Toxin Binder		1.00	1.00	1.00	1.00	1.00	1.00
Coccidiostat		0.50	0.50	0.50	0.50	0.50	0.50
Liver Tonic		0.50	0.50	0.50	0.50	0.50	0.50
Vit E and Se		0.25	0.25	0.25	0.25	0.25	0.25
NSP Enzyme		0.00	0.00	0.00	0.25	0.25	0.25
Phytase 5000		0.00	0.00	0.00	0.10	0.10	0.10

Table 43. Layer feed formulae (kg/ton)

Ingredient	Age (Weeks)				
	0-8	9-16	17-20	21-45	46-90
Maize	273.5	262.5	337.9	334.2	326.5
Rice Broken	150.0	150.0	150.0	150.0	150.0
Bajra	150.0	150.0	150.0	150.0	150.0
Oil-Veg	21.90	0.00	0.00	0.00	0.00
Soybean meal 45%	181.2	72.47	206.2	163.4	142.9
Guar Meal	50.00	40.00	40.00	50.00	50.00
Rapeseed meal	30.00	20.00	20.00	30.00	20.00
Deoiled Rice Bran	100.0	268.1	22.35	0.00	23.62
Dicalcium Phosphate	15.94	13.17	11.69	12.18	11.30
LSP-Powder	16.23	12.69	50.61	40.00	40.00
Stone Grit	0.00	0.00	0.00	57.83	73.81
Salt	2.75	2.66	2.82	2.59	2.60
Sodium bi-carbonate	1.50	1.50	1.50	1.50	1.50
Vitamin Premix	0.50	0.50	0.50	0.50	0.50
Trace Mineral Mixture	1.00	1.00	1.00	1.00	1.00
DL-Methionine	0.88	0.39	1.43	2.34	2.18
L-Lysine Hcl	1.38	1.77	0.78	0.79	0.99
L-Threonine	0.00	0.00	0.00	0.89	0.33
Choline Chloride,75%	1.00	1.00	1.00	1.00	1.00
Toxin Binder	1.00	1.00	1.00	1.00	1.00
Coccidiostat	0.50	0.50	0.50	0.00	0.00
Liver Tonic	0.50	0.50	0.50	0.50	0.50
Vit E and Se	0.25	0.25	0.25	0.25	0.25



Table 44. Layer feed formulae (kg/ton) with Enzymes

Ingredient	Age (Weeks)				
	0-8	9-16	17-20	21-45	46-90
Maize	205.8	209.0	279.1	290.1	281.6
Rice Broken	150.0	150.0	150.0	150.0	150.0
Bajra	150.0	150.0	150.0	150.0	150.0
Oil-Veg	24.62	0.00	0.00	0.00	0.00
Soybean meal 45%	104.5	0.00	121.1	100.9	39.73
Rapeseed meal	30.00	20.00	20.00	30.00	20.00
Guar Meal	50.00	40.00	40.00	50.00	50.00
Deoiled Rice Bran	250.0	400.0	170.3	103.7	181.2
Dicalcium Phosphate	6.97	4.26	2.82	3.38	2.50
LSP-Powder	16.78	0.00	51.19	40.00	40.00
Stone Grit	0.00	14.10	0.00	69.98	74.53
Salt	2.65	2.83	2.73	2.53	2.51
Sodium bi-carbonate	1.50	1.50	1.50	1.50	1.50
Vitamin Premix	0.50	0.50	0.50	0.50	0.50
Trace Mineral Mixture	1.00	1.00	1.00	1.00	1.00
DL-Methionine	0.41	0.00	1.04	1.95	0.27
L-Lysine Hcl	1.69	2.08	5.00	0.98	1.39
L-Threonine	0.00	0.00	0.00	0.21	0.00
L-Tryptophan	0.00	0.13	0.17	0.18	0.10
Choline Chloride,75%	1.00	1.00	1.00	1.00	1.00
Toxin Binder	1.00	1.00	1.00	1.00	1.00
Coccidiostat	0.50	0.50	0.50	0.00	0.00
Liver Tonic	0.50	1.53	0.50	0.50	0.50
Vit E and Se	0.25	0.25	0.25	0.25	0.25
NSP Enzyme	0.25	0.25	0.25	0.25	0.25
Phytase 5000	0.12	0.12	0.12	0.12	0.12



Table 45. Broiler feed formulae (kg/ton)

Ingredient	Age, days	No Enzyme			With enzymes		
		1-14	15-28	29-42	1-14	15-28	29-42
Maize		377.1	192.0	253.3	370.8	281.0	342.2
Rice Broken		23.07	150.0	150.0	115.1	150.0	150.0
Bajra		100.0	100.0	100.0	100.0	100.0	100.0
Wheat Broken		0.00	100.0	100.0	0.00	100.0	100.0
Oil-Veg		54.09	63.47	59.58	23.63	29.52	25.66
Soybean meal 45%		295.7	254.2	196.1	247.0	201.8	147.4
Rapeseed meal		30.00	30.00	30.00	30.00	30.00	30.00
Cotton Seed Meal 42%		40.00	40.00	40.00	40.00	40.00	40.00
Guar Meal		30.00	26.41	30.00	30.00	30.00	30.00
Dicalcium Phosphate		18.29	15.95	15.23	11.17	8.85	8.12
LSP-Powder		14.28	14.38	12.25	14.56	14.80	12.69
Salt		3.25	2.94	2.71	3.11	2.95	2.71
Sodium bi-carbonate		1.50	1.50	1.50	1.50	1.50	1.50
Vitamin Premix		0.50	0.50	0.50	0.50	0.50	0.50
Trace Mineral Mixture		1.00	1.00	1.00	1.00	1.00	1.00
DL-Methionine		3.34	2.05	1.73	3.09	1.81	1.49
L-Lysine Hcl		3.57	2.10	2.57	3.87	2.49	2.91
L-Threonine		1.00	0.28	0.31	1.00	0.21	0.22
L-Tryptophan		0.00	0.00	0.00	0.06	0.00	0.00
Choline Chloride,75%		1.00	1.00	1.00	1.00	1.00	1.00
Toxin Binder		1.00	1.00	1.00	1.00	1.00	1.00
Coccidiostat		0.50	0.50	0.50	0.50	0.50	0.50
Liver Tonic		0.50	0.50	0.50	0.50	0.50	0.50
Vit E and Se		0.25	0.25	0.25	0.25	0.25	0.25
NSP Enzyme		0.00	0.00	0.00	0.25	0.25	0.25
Phytase 5000		0.00	0.00	0.00	0.10	0.10	0.10



Table 46. Layer feed formulae (kg/ton)

Ingredient	Age (Weeks)				
	0-8	9-16	17-20	21-45	46-90
Maize	225.5	227.8	304.2	414.0	292.4
Rice Broken	150.0	150.0	150.0	22.71	150.0
Wheat Broken	100.0	100.0	100.0	100.0	100.0
Bajra	100.0	100.0	100.0	100.0	100.0
Oil-Veg	25.21	0.00	0.00	0.00	0.00
Soybean meal 45%	154.9	65.70	165.8	138.5	137.7
Guar Meal	30.00	20.00	30.00	30.00	20.00
Cotton Seed Meal 42%	40.00	20.00	40.00	40.00	30.00
Rapeseed meal	30.00	20.00	30.00	30.00	20.00
Deoiled Rice Bran	100.0	259.0	5.45	0.00	12.25
Dicalcium Phosphate	16.09	13.42	11.82	12.36	11.50
LSP-Powder	16.45	12.79	50.70	40.00	40.00
Stone Grit	0.00	0.00	0.00	59.96	74.05
Salt	2.63	2.56	2.70	2.67	2.50
Sodium bi-carbonate	1.50	1.50	1.50	1.50	1.50
Vitamin Premix	0.50	0.50	0.50	0.50	0.50
Trace Mineral Mixture	1.00	1.00	1.00	1.00	1.00
DL-Methionine	0.93	0.44	1.47	2.41	2.24
L-Lysine Hcl	2.00	2.05	1.59	1.42	1.31
L-Threonine	0.00	0.00	0.00	0.29	0.40
L-Tryptophan	0.00	0.00	0.00	0.02	0.00
Choline Chloride,75%	1.00	1.00	1.00	1.00	1.00
Toxin Binder	1.00	1.00	1.00	1.00	1.00
Coccidiostat	0.50	0.50	0.50	0.00	0.00
Liver Tonic	0.50	0.50	0.50	0.50	0.50
Vit E and Se	0.25	0.25	0.25	0.25	0.25



Table 47. Layer feed formulae (kg/ton) with Enzymes

Ingredient	Age (Weeks)				
	0-8	9-16	17-20	21-45	46-90
Maize	211.1	175.6	248.3	256.1	236.6
Rice Broken	150.0	150.0	150.0	150.0	150.0
Wheat Broken	100.0	100.0	100.0	100.0	100.0
Bajra	100.0	100.0	100.0	100.0	100.0
Oil-Veg	15.36	0.00	0.00	0.00	0.00
Soybean meal 45%	87.30	0.00	90.79	76.76	62.72
Deoiled Rice Bran	200.0	384.9	144.5	90.62	151.0
Cotton Seed Meal 42%	40.00	20.00	40.00	40.00	30.00
Rapeseed meal	30.00	20.00	30.00	30.00	20.00
Guar Meal	30.00	20.00	30.00	30.00	20.00
Dicalcium Phosphate	7.25	4.47	2.88	3.57	2.57
LSP-Powder	16.98	13.30	51.25	40.00	40.00
Stone Grit	0.00	0.00	0.00	70.21	74.63
Salt	2.57	2.73	2.61	2.42	2.41
Sodium bi-carbonate	1.50	1.50	1.50	1.50	1.50
Vitamin Premix	0.50	0.50	0.50	0.50	0.50
Trace Mineral Mixture	1.00	1.00	1.00	1.00	1.00
DL-Methionine	0.53	0.04	1.01	2.02	1.78
L-Lysine Hcl	2.32	2.34	1.92	1.61	1.64
L-Threonine	0.00	0.00	0.00	0.32	0.32
L-Tryptophan	0.00	0.10	0.17	0.21	0.23
Choline Chloride,75%	1.00	1.00	1.00	1.00	1.00
Toxin Binder	1.00	1.00	1.00	1.00	1.00
Coccidiostat	0.50	0.50	0.50	0.00	0.00
Liver Tonic	0.50	0.50	0.50	0.50	0.50
Vit E and Se	0.25	0.25	0.25	0.25	0.25
NSP Enzyme	0.25	0.21	0.25	0.25	0.25
Phytase 5000	0.12	0.12	0.12	0.12	0.12



Table 48. Broiler feed formulae (kg/ton)

Ingredient	Age, days	No Enzyme			With enzymes		
		1-14	15-28	29-42	1-14	15-28	29-42
Maize		206.5	247.6	304.9	368.9	331.2	387.7
Rice Broken		150.0	150.0	150.0	71.32	150.0	150.0
Wheat Broken		150.0	150.0	150.0	150.0	150.0	150.0
Oil-Veg		60.73	60.07	57.22	26.56	27.68	25.14
Soybean meal 45%		333.2	289.5	228.1	278.6	234.0	172.8
Rapeseed meal		50.00	60.00	70.00	60.00	70.00	80.00
Dicalcium Phosphate		18.65	15.99	15.16	11.44	8.78	7.95
LSP-Powder		13.75	14.14	11.97	14.27	14.52	12.34
Salt		2.91	2.90	2.64	3.02	2.88	2.62
Sodium bi-carbonate		1.50	1.50	1.50	1.50	1.50	1.50
Vitamin Premix		0.50	0.50	0.50	0.50	0.50	0.50
Trace Mineral Mixture		1.00	1.00	1.00	1.00	1.00	1.00
DL-Methionine		3.25	2.00	1.65	2.98	1.74	1.38
L-Lysine Hcl		2.81	1.36	1.83	3.20	1.75	2.22
L-Threonine		1.16	0.23	0.24	1.00	0.15	0.16
L Arginine		0.74	0.00	0.00	2.15	0.70	1.10
Choline Chloride,75%		1.00	1.00	1.00	1.00	1.00	1.00
Toxin Binder		1.00	1.00	1.00	1.00	1.00	1.00
Coccidiostat		0.50	0.50	0.50	0.50	0.50	0.50
Liver Tonic		0.50	0.50	0.50	0.50	0.50	0.50
Vit E and Se		0.25	0.25	0.25	0.25	0.25	0.25
NSP Enzyme		0.00	0.00	0.00	0.25	0.25	0.25
Phytase 5000		0.00	0.00	0.00	0.10	0.10	0.10

Table 49. Layer feed formulae (kg/ton)

Ingredient	Age (Weeks)				
	0-8	9-16	17-20	21-45	46-90
Maize	281.2	269.2	345.4	341.6	333.8
Rice Broken	150.0	150.0	150.0	150.0	150.0
Wheat Broken	150.0	150.0	150.0	150.0	150.0
Oil-Veg	21.82	0.00	0.00	0.00	0.00
Soybean meal 45%	193.7	81.03	202.2	176.4	155.3
Deoiled Rice Bran	100.0	272.8	18.95	0.00	24.03
Rapeseed meal	60.00	40.00	60.00	60.00	50.00
Dicalcium Phosphate	16.12	13.46	11.81	12.37	11.49
LSP-Powder	16.23	12.69	50.49	40.00	40.00
Stone Grit	0.00	0.00	0.00	57.83	73.82
Salt	2.59	2.52	2.65	2.43	2.44
Sodium bi-carbonate	1.50	1.50	1.50	1.50	1.50
Vitamin Premix	0.50	0.50	0.50	0.50	0.50
Trace Mineral Mixture	1.00	1.00	1.00	1.00	1.00
DL-Methionine	0.89	0.42	1.41	2.34	2.18
L-Lysine Hcl	1.21	1.68	0.80	0.61	0.82
L-Threonine	0.00	0.00	0.00	0.66	0.38
Choline Chloride,75%	1.00	1.00	1.00	1.00	1.00
Toxin Binder	1.00	1.00	1.00	1.00	1.00
Coccidiostat	0.50	0.50	0.50	0.00	0.00
Liver Tonic	0.50	0.50	0.50	0.50	0.50
Vit E and Se	0.25	0.25	0.25	0.25	0.25



Table 50. Layer feed formulae (kg/ton) with Enzymes

Ingredient	Age (Weeks)				
	0-8	9-16	17-20	21-45	46-90
Maize	335.0	257.6	289.0	316.3	278.0
Rice Broken	150.0	150.0	150.0	150.0	150.0
Wheat Broken	150.0	150.0	150.0	150.0	150.0
Soybean meal 45%	151.6	66.05	133.5	140.1	80.38
Deoiled Rice Bran	100.0	302.0	162.0	58.60	162.8
Rapeseed meal	60.00	40.00	50.00	60.00	50.00
Dicalcium Phosphate	7.62	4.60	2.96	3.57	2.55
LSP-Powder	34.11	0.00	51.10	40.00	40.00
Stone Grit	0.00	13.80	0.00	69.85	74.40
Salt	2.60	2.76	2.58	2.40	2.36
Sodium bi-carbonate	1.50	1.50	1.50	1.50	1.50
Vitamin Premix	0.50	0.50	0.50	0.50	0.50
Trace Mineral Mixture	1.00	1.20	1.00	1.00	1.00
DL-Methionine	0.69	0.33	0.98	2.12	1.73
L-Lysine Hcl	1.42	1.75	1.07	0.72	1.15
L-Threonine	0.00	0.00	0.00	0.29	0.29
L-Tryptophan	0.00	0.00	0.14	0.09	0.23
L Arginine	0.34	0.00	0.04	0.00	0.00
Choline Chloride,75%	1.00	1.00	1.00	1.00	1.00
Toxin Binder	1.00	1.00	1.00	1.00	1.00
Coccidiostat	0.50	0.50	0.50	0.00	0.00
Liver Tonic	0.50	5.00	0.50	0.50	0.50
Vit E and Se	0.25	0.25	0.25	0.25	0.25
Enzyme	0.25	0.05	0.25	0.15	0.25
Phytase 5000	0.12	0.12	0.12	0.12	0.12



Table 51. Broiler feed formulae (kg/ton)

Ingredient	Age, days	No Enzyme			With enzymes		
		1-14	15-28	29-42	1-14	15-28	29-42
Maize		467.1	266.0	327.2	458.6	355.0	327.1
Rice Broken		15.15	250.0	250.0	107.2	250.0	250.0
Oil-Veg		51.67	59.81	55.95	21.92	25.90	55.95
Soybean meal 45%		326.7	291.6	237.2	278.5	242.8	236.9
Til cake / Sesame Meal		50.00	50.00	50.00	50.00	50.00	50.00
Rapeseed meal		40.00	40.00	40.00	40.00	40.00	40.00
Dicalcium Phosphate		17.39	14.77	14.04	10.27	7.65	14.04
LSP-Powder		14.92	14.97	12.86	15.20	15.41	12.86
Salt		3.28	2.93	2.69	3.14	2.94	2.69
Sodium bi-carbonate		1.50	1.50	1.50	1.50	1.50	1.50
DL-Methionine		3.19	1.91	1.59	2.94	1.68	1.59
L-Lysine Hcl		3.17	1.51	1.92	3.46	1.85	1.92
L-Threonine		1.00	0.26	0.27	1.00	0.18	0.28
L-Tryptophan		0.00	0.00	0.00	0.06	0.00	0.00
L Arginine		0.13	0.00	0.00	1.11	0.00	0.00
Choline Chloride,75%		1.00	1.00	1.00	1.00	1.00	1.00
Toxin Binder		1.00	1.00	1.00	1.00	1.00	1.00
Vitamin Premix		0.50	0.50	0.50	0.50	0.50	0.50
Trace Mineral Mixture		1.00	1.00	1.00	1.00	1.00	1.00
Coccidiostat		0.50	0.50	0.50	0.50	0.50	0.50
Liver Tonic		0.50	0.50	0.50	0.50	0.50	0.50
Vit E and Se		0.25	0.25	0.25	0.25	0.25	0.25
NSP Enzyme		0.00	0.00	0.00	0.25	0.25	0.25
Phytase 5000		0.00	0.00	0.00	0.10	0.10	0.10



Table 52. Layer feed formulae (kg/ton)

Ingredient	Age (Weeks)				
	0-8	9-16	17-20	21-45	46-72
Maize	158.1	287.9	363.7	359.1	351.2
Rice Broken	250.0	250.0	250.0	250.0	250.0
Wheat Broken	150.0	0.00	0.00	0.00	0.00
Oil-Veg	28.39	0.00	0.00	0.00	0.00
Soybean meal 45%	180.2	87.87	215.3	179.1	157.3
Deoiled Rice Bran	100.0	277.6	27.83	0.38	24.88
Til cake / Sesame Meal	50.00	40.00	40.00	50.00	50.00
Rapeseed meal	40.00	20.00	30.00	40.00	30.00
Dicalcium Phosphate	15.34	12.42	10.86	11.14	10.26
LSP-Powder	16.80	13.40	51.26	40.00	40.00
Stone Grit	0.00	0.00	0.00	58.72	74.70
Salt	2.44	2.56	2.71	2.46	2.48
Sodium bi-carbonate	1.50	1.50	1.50	1.50	1.50
Vitamin Premix	0.50	0.50	0.50	0.50	0.50
Trace Mineral Mixture	1.00	1.00	1.00	1.00	1.00
DL-Methionine	0.75	0.35	1.37	2.23	2.08
L-Lysine Hcl	1.68	1.70	0.76	0.73	0.97
L-Threonine	0.09	0.00	0.00	0.37	0.41
Choline Chloride,75%	1.00	1.00	1.00	1.00	1.00
Toxin Binder	1.00	1.00	1.00	1.00	1.00
Coccidiostat	0.50	0.50	0.50	0.00	0.00
Liver Tonic	0.50	0.50	0.50	0.50	0.50
Vit E and Se	0.25	0.25	0.25	0.25	0.25



Table 53. Layer feed formulae (kg/ton) with Enzymes

Ingredient	Age (Weeks)				
	0-8	9-16	17-20	21-45	46-90
Maize	231.0	281.4	307.7	314.7	295.4
Rice Broken	250.0	250.0	250.0	250.0	250.0
Wheat Broken	150.0	0.00	0.00	0.00	0.00
Soybean meal 45%	134.5	78.04	140.3	115.3	82.35
Deoiled Rice Bran	100.0	301.0	166.9	104.9	163.6
Til cake / Sesame Meal	50.00	40.00	40.00	50.00	50.00
Rapeseed meal	40.00	20.00	30.00	40.00	30.00
Dicalcium Phosphate	6.79	3.53	1.92	2.34	1.33
LSP-Powder	26.13	0.00	51.81	40.00	40.00
Stone Grit	0.00	14.54	0.00	70.87	75.29
DL-Methionine	0.53	0.29	0.91	1.86	1.63
Salt	2.44	2.80	2.62	2.40	2.39
Sodium bi-carbonate	1.50	1.50	1.50	1.50	1.50
Vitamin Premix	0.50	0.50	0.50	0.50	0.50
Trace Mineral Mixture	1.00	1.20	1.00	1.00	1.00
L-Lysine Hcl	1.96	1.76	1.09	0.96	1.29
L-Threonine	0.02	0.00	0.00	0.29	0.33
L-Tryptophan	0.00	0.00	0.13	0.18	0.24
Choline Chloride,75%	1.00	1.00	1.00	1.00	1.00
Toxin Binder	1.00	1.00	1.00	1.00	1.00
Coccidiostat	0.50	0.50	0.50	0.00	0.00
Liver Tonic	0.50	0.50	0.50	0.50	0.50
Vit E and Se	0.25	0.25	0.25	0.25	0.25
Enzyme	0.25	0.02	0.25	0.25	0.25
Phytase 5000	0.12	0.12	0.12	0.12	0.12



Table 54. Broiler feed formulae (kg/ton)

Ingredient	Age, days	No Enzyme			With enzymes		
		1-14	15-28	29-42	1-14	15-28	29-42
Maize		507.9	281.5	342.7	525.5	370.4	431.6
Rice Broken		0.00	250.0	250.0	62.56	250.0	250.0
Oil-Veg		43.83	55.75	51.89	13.79	21.84	17.98
Soybean meal 45%		356.3	319.6	265.2	303.2	270.8	216.4
Til cake / Sesame Meal		41.70	50.00	50.00	50.00	50.00	50.00
Dicalcium Phosphate		18.03	15.16	14.43	10.76	8.05	7.32
LSP-Powder		15.04	15.21	13.11	15.47	15.66	13.55
Salt		3.39	3.02	2.78	3.29	3.02	2.78
Sodium bi-carbonate		1.50	1.50	1.50	1.50	1.50	1.50
Vitamin Premix		0.50	0.50	0.50	0.50	0.50	0.50
Trace Mineral Mixture		1.00	1.00	1.00	1.00	1.00	1.00
DL-Methionine		3.43	2.05	1.73	3.16	1.82	1.50
L-Lysine Hcl		3.00	1.29	1.71	3.41	1.63	2.05
L-Threonine		1.00	0.26	0.27	1.00	0.17	0.19
L-Tryptophan		0.00	0.00	0.00	0.07	0.00	0.00
L Arginine		0.20	0.00	0.00	1.20	0.00	0.00
Choline Chloride,75%		1.00	1.00	1.00	1.00	1.00	1.00
Toxin Binder		1.00	1.00	1.00	1.00	1.00	1.00
Coccidiostat		0.50	0.50	0.50	0.50	0.50	0.50
Liver Tonic		0.50	0.50	0.50	0.50	0.50	0.50
Vit E and Se		0.25	0.25	0.25	0.25	0.25	0.25
NSP Enzyme		0.00	0.00	0.00	0.25	0.25	0.25
Phytase 5000		0.00	0.00	0.00	0.10	0.10	0.10

Table 55. Layer feed formulae (kg/ton)

Ingredient	Age (Weeks)				
	0-8	9-16	17-20	21-45	46-90
Maize	315.0	287.0	362.3	362.3	349.9
Rice Broken	250.0	250.0	250.0	250.0	250.0
Oil-Veg	17.51	0.00	0.00	0.00	0.00
Soybean meal 45%	223.9	100.4	234.1	208.9	176.1
Deoiled Rice Bran	100.0	285.7	39.95	1.80	36.95
Til cake / Sesame Meal	50.00	40.00	40.00	50.00	50.00
Dicalcium Phosphate	15.30	12.60	11.13	11.56	10.53
LSP-Powder	17.31	13.53	51.45	40.00	40.00
Stone Grit	0.00	0.00	0.00	63.95	74.91
Salt	2.70	2.60	2.76	2.55	2.53
Sodium bi-carbonate	1.50	1.50	1.50	1.50	1.50
Trace Mineral Mixture	1.00	1.00	1.00	1.00	1.00
Vitamin Premix	0.50	0.50	0.50	0.50	0.50
DL-Methionine	0.93	0.41	1.45	2.38	2.17
L-Lysine Hcl	1.14	1.59	0.60	0.47	00.80
L-Threonine	0.00	0.00	0.00	0.37	0.41
Choline Chloride,75%	1.00	1.00	1.00	1.00	1.00
Vit E and Se	0.25	0.25	0.25	0.25	0.25
Toxin Binder	1.00	1.00	1.00	1.00	1.00
Coccidiostat	0.50	0.50	0.50	0.00	0.00
Liver Tonic	0.50	0.50	0.50	0.50	0.50

Table 56. Layer feed formulae (kg/ton) with Enzymes

Ingredient	Age (Weeks)				
	0-8	9-16	17-20	21-45	46-90
Maize	362.4	282.6	306.3	313.0	294.1
Rice Broken	250.0	250.0	250.0	250.0	250.0
Soybean meal 45%	201.9	95.15	159.1	140.4	101.2
Deoiled Rice Bran	100.0	301.0	179.0	121.1	175.7
Til cake / Sesame Meal	50.00	40.00	40.00	50.00	50.00
Dicalcium Phosphate	6.55	3.71	2.19	2.70	1.59
LSP-Powder	17.63	0.00	52.00	40.00	40.00
Stone Grit	0.00	14.65	0.00	71.15	75.49
Salt	2.95	2.84	2.67	2.47	2.44
Sodium bi-carbonate	1.50	1.50	1.50	1.50	1.50
Vitamin Premix	0.50	0.50	0.50	0.50	0.50
Trace Mineral Mixture	1.00	1.00	1.00	1.00	1.00
DL-Methionine	0.82	0.37	1.00	1.98	1.72
L-Lysine Hcl	1.32	1.64	0.92	0.74	1.13
L-Threonine	0.00	0.00	0.00	0.28	0.32
L-Tryptophan	0.00	0.00	0.12	0.17	0.22
L Arginine	0.00	0.00	0.00	0.00	0.00
Choline Chloride,75%	1.00	2.66	1.00	1.00	1.00
Toxin Binder	1.00	1.00	1.00	1.00	1.00
Coccidiostat	0.50	0.50	0.50	0.00	0.00
Liver Tonic	0.50	0.50	0.50	0.50	0.50
Vit E and Se	0.25	0.25	0.25	0.25	0.25
Enzyme	0.10	0.00	0.25	0.25	0.25
Phytase 5000	0.12	0.12	0.12	0.12	0.12
Maize	362.36	282.62	306.31	312.96	294.08
Rice Broken - 1	250.00	250.00	250.00	250.00	250.00
Soybean meal 45%	201.90	95.15	159.14	140.40	101.17
Deoiled Rice Bran	100.00	301.00	179.03	121.05	175.72
Til cake / Sesame Meal	50.00	40.00	40.00	50.00	50.00
Dicalcium Phosphate	6.55	3.71	2.19	2.70	1.59
LSP-Powder	17.63	0.00	52.00	40.00	40.00
Stone Grit	0.00	14.65	0.00	71.15	75.49
Salt	2.95	2.84	2.67	2.47	2.44

Table 57. Broiler feed formulae (kg/ton)

Ingredient	Age, days	No Enzyme			With enzymes		
		1-14	15-28	29-42	1-14	15-28	29-42
Maize		362.4	191.1	244.6	352.0	279.6	332.2
Rice Broken		44.95	250.0	250.0	138.8	250.0	250.0
Wheat Broken		100.0	100.0	100.0	100.0	100.0	100.0
Oil-Veg		54.59	61.54	59.71	24.89	27.77	26.26
Soybean meal 45%		338.3	295.0	226.7	290.1	246.3	178.1
Rapeseed meal		50.00	60.00	80.00	50.00	60.00	80.00
Dicalcium Phosphate		18.52	15.82	14.90	11.40	8.71	7.79
LSP-Powder		14.02	14.05	11.82	14.29	14.49	12.26
Salt		3.13	2.81	2.53	3.00	2.81	2.53
Sodium bi-carbonate		1.50	1.50	1.50	1.50	1.50	1.50
Vitamin Premix		0.50	0.50	0.50	0.50	0.50	0.50
Trace Mineral Mixture		1.00	1.00	1.00	1.00	1.00	1.00
DL-Methionine		3.29	1.99	1.61	3.03	1.76	1.37
L-Lysine Hcl		2.76	1.20	1.73	3.04	1.54	2.06
L-Threonine		1.00	0.25	0.26	1.00	0.17	0.18
L-Tryptophan		0.00	0.00	0.00	0.01	0.00	0.00
L Arginine		0.79	0.00	0.00	1.75	0.20	0.64
Choline Chloride,75%		1.00	1.00	1.00	1.00	1.00	1.00
Toxin Binder		1.00	1.00	1.00	1.00	1.00	1.00
Coccidiostat		0.50	0.50	0.50	0.50	0.50	0.50
Liver Tonic		0.50	0.50	0.50	0.50	0.50	0.50
Vit E and Se		0.25	0.25	0.25	0.25	0.25	0.25
NSP Enzyme		0.00	0.00	0.00	0.25	0.25	0.25
Phytase 5000		0.00	0.00	0.00	0.10	0.10	0.10

Table 58. Layer feed formulae (kg/ton)

Ingredient	Age (Weeks)				
	0-8	9-16	17-20	21-45	46-90
Maize	247.8	218.9	294.7	229.4	283.1
Rice Broken	250.0	250.0	250.0	250.0	250.0
Wheat Broken	100.0	100.0	100.0	100.0	100.0
Oil-Veg	17.20	0.00	0.00	0.00	0.00
Soybean meal 45%	241.3	87.68	215.1	123.9	168.2
Deoiled Rice Bran	100.0	266.9	17.11	178.90	22.22
Rapeseed meal	0.00	40.00	50.00	60.00	40.00
Dicalcium Phosphate	16.56	13.31	11.75	11.46	11.43
LSP-Powder	16.51	12.60	50.46	35.22	40.00
Stone Grit	0.00	0.00	0.00	0.00	73.79
Salt	2.62	2.44	2.58	2.20	2.38
Sodium bi-carbonate	1.50	1.50	1.50	1.50	1.50
Vitamin Premix	0.50	0.50	0.50	0.50	0.50
Trace Mineral Mixture	1.00	1.00	1.00	1.00	1.00
DL-Methionine	1.09	0.42	1.43	1.89	2.21
L-Lysine Hcl	0.73	1.52	0.59	0.92	0.61
L-Threonine	0.00	0.00	0.00	0.33	0.40
Choline Chloride,75%	1.00	1.00	1.00	1.00	1.00
Toxin Binder	1.00	1.00	1.00	1.00	1.00
Coccidiostat	0.50	0.50	0.50	0.00	0.00
Liver Tonic	0.50	0.50	0.50	0.50	0.50
Vit E and Se	0.25	0.25	0.25	0.25	0.25



Table 59. Layer feed formulae (kg/ton) with Enzymes

Ingredient	Age (Weeks)				
	0-8	9-16	17-20	21-45	46-90
Maize	233.3	162.9	238.7	247.0	227.2
Rice Broken	250.0	250.0	250.0	250.0	250.0
Wheat Broken	100.0	100.0	100.0	100.0	100.0
Oil-Veg	7.35	0.00	0.00	0.00	0.00
Soybean meal 45%	173.7	12.76	140.2	120.0	93.30
Deoiled Rice Bran	200.0	405.8	156.2	98.28	161.0
Rapeseed meal	0.00	40.00	50.00	60.00	40.00
Dicalcium Phosphate	7.71	4.38	2.82	3.42	2.49
LSP-Powder	17.04	13.15	51.01	40.00	40.00
Stone Grit	0.00	0.00	0.00	69.89	74.37
Salt	2.56	2.35	2.49	2.28	2.29
Sodium bi-carbonate	1.50	1.50	1.50	1.50	1.50
Vitamin Premix	0.50	0.50	0.50	0.50	0.50
Trace Mineral Mixture	1.00	1.00	1.00	1.00	1.00
DL-Methionine	0.69	0.00	0.98	1.96	1.75
L-Lysine Hcl	1.06	1.85	0.91	0.66	0.93
L-Threonine	0.00	0.00	0.00	0.27	0.31
L-Tryptophan	0.00	0.12	0.11	0.15	0.20
L Arginine	0.00	0.10	0.00	0.00	0.00
Choline Chloride,75%	1.00	1.00	1.00	1.00	1.00
Toxin Binder	1.00	1.00	1.00	1.00	1.00
Coccidiostat	0.50	0.50	0.50	0.00	0.00
Liver Tonic	0.50	0.50	0.50	0.50	0.50
Vit E and Se	0.25	0.25	0.25	0.25	0.25
Enzyme	0.25	0.25	0.25	0.25	0.25
Phytase 5000	0.12	0.12	0.12	0.12	0.12



Backyard Poultry



Backyard Poultry Farming

In the recent times, the demand for egg and chicken meat from the rural / backyard / family / free range poultry farming with improved chicken varieties gained popularity for ethnic and ecological reasons.

Based on the rearing practices across the country, a five type production systems were identified in backyard poultry farming (BYPF) which include

1. **Nursery phase:** During initial 6 weeks of age, where day old chicks are reared in confinement by providing all the inputs till the bird gain 500-700 g body weight, after which will be left in free range for scavenge feeding,
2. **Birds for meat production:** In this system the improved chicken varieties are reared in intensive system till they attain the desired body weight i.e. about 1.5 kg in 1-12/15 weeks of age for meat purpose. In this system nutritionally balanced feed is provided ad libitum to attain higher weight gain at the earliest possible age.
3. **Semi intensive farming:** In this system birds are housed in night shelter during night time and left for scavenge feeding during the day time. Based on the available quantity of the natural feed base, a measured quantity of feed rich in vitamins and minerals is offered @ 50 g /b/day in the evening so as to get the expected production from these birds.
- 4 & 5. **Breeder- layer & dual purpose breeds:** At many places, both government and private organizations are rearing the parents of egg type and dual type improved rural chicken germplasm for which the feed formulae were presented for four major geographic regions of the country.

The nutrient requirement of backyard poultry vary with the rearing practice and the variety of the bird (Table 61).

Feed NSP Enzymes have a great role to maintain bird health besides reducing the cost of feeding. Therefore, all the diets were formulated without and with NSP Enzymes like fibre hydrolysing NSP Enzymes and phytase, which considerably reduced the feed cost based on prime and alternate feed ingredients.

Similar to the commercial poultry farming, for the convenience of rural poultry farmers, the country was made in to four regions and formulated the diets based on the availability feed ingredients as indicated in Table . The formulations were made utilizing the regions specific feed ingredients available along with the maize and soybean meal as the basal feed ingredients. The levels of these expensive ingredients were reduced to the possible extent utilizing the alternate feed ingredients available in the specific region to maintain the production with an aim of minimizing the production cost.

Backyard Poultry Farming

Table 60. Region number, geographic states and availability of feed ingredients

Region	States	Available feed ingredients
East	Odisha, West Bengal, Bihar, Jharkhand	Wheat broken, broken rice, rape seed meal, till / sesame cake
North	Haryana, Punjab, Rajasthan, Utter Pradesh, Uttarakhand, Madhya Pradesh, Chhattisgarh	Wheat broken, rice broken, bajra, rape seed meal, guar meal
South	Andhra Pradesh, Telangana, Tamil Nadu, Karnataka, Kerala	Rice broken, ragi, sorghum, til/sesame cake, sunflower cake, groundnut cake
West	Maharashtra, Gujarat	Rice broken, sorghum, cotton seed meal, ground nut meal, rape seed meal

Ad hoc diet for free range poultry: Chicken get highly diversified nutrition in the free range conditions, which depends on several factors like geographic location, agricultural practices, weather variables, food habits of population, etc. The natural food base available under free range conditions may include insects, greens, fallen grains, kitchen offal, etc. Therefore, composition of the natural food base is highly variable, but certainly rich in either protein and or carbohydrates, which means that the birds under free range rearing may get protein and energy at variable concentrations. Based on the availability of these ingredients, the birds may partially or completely fulfill its requirement for the natural food base. Under such conditions, it is quite common to observe deficiency symptoms of mineral and vitamins at variable degree. It is essential to provide critical vitamins and minerals to prevent deficiency disorders and realize expected production from the birds. Therefore, it will be a prudent to prepare a vitamin and mineral premix in either available cereal (wheat or rice) or their by-products (respective brans) as the base material. Supplementation of such ad hoc diet rich in vitamins and minerals will improve the health and productivity of birds under free range farming conditions.

Table 61. Nutrient requirements (%) for backyard chicken

Nutrient	Nursery	SI	Meat purpose	Breeder	
				Layer	Dual
M.E (kcal / kg)	2600	2700	2800	2600	2750
Protein	17.0	17.0	20.0	16.5	15.5
Dig. Lysine	0.85	0.85	1.00	0.75	0.73
Dig. Meth+Cyst.	0.76	0.68	0.85	0.65	0.64
Dig. Arginine	1.02	1.01	1.185	1.00	0.95
Dig. Tryptophan	0.17	0.185	0.216	0.18	0.18
Dig. Threonine	0.59	0.72	0.72	0.72	0.65
Calcium	0.80	5.00	1.00	3.50	3.10
Avail Phosphorus	0.35	0.50	0.40	0.32	0.33
Sodium	0.18	0.18	0.18	0.18	0.18

Table 62. Maize-SBM based feed formulae (kg/ton)

Ingredient	Nursery	Meat type	SI	Breeder	
				Layer	Dual
Maize	500.9	600.2	501.4	590.9	681.6
Oil-Veg	0.00	0.00	47.21	0.00	0.00
Soybean meal 45%	139.5	295.2	267.9	205.1	192.0
Deoiled Rice Bran	319.1	58.69	0.00	78.13	9.60
Dicalcium Phosphate	13.15	16.13	23.43	12.49	13.51
LSP-Powder	13.38	16.94	80.00	80.00	40.00
Stone Grit	0.00	0.00	61.56	19.56	48.54
Salt	2.98	3.14	2.20	3.17	3.22
Sodium bi-carbonate	1.50	1.50	3.00	1.50	1.50
Vitamin Premix	0.50	0.50	1.00	0.50	0.50
Trace Mineral Mixture	1.00	1.00	2.00	1.00	1.00
DL-Methionine	2.08	2.73	2.08	1.64	1.89
L-Lysine Hcl	1.88	0.63	0.44	0.32	0.92
L-Threonine	0.03	0.19	1.33	1.56	1.21
L-Tryptophan	0.06	0.00	0.00	0.13	0.28
L Arginine	0.77	0.00	0.00	0.74	1.02
Choline Chloride,75%	1.00	1.00	2.00	1.00	1.00
Toxin Binder	1.00	1.00	2.00	1.00	1.00
Coccidiostat	0.50	0.50	1.00	0.50	0.50
Liver Tonic	0.50	0.50	1.00	0.50	0.50
Vit E and Se	0.25	0.25	0.50	0.25	0.25

SI : Semi intensive



Table 63. Maize-SBM based feed formulae (kg/ton) with Enzymes

Ingredient	Nursery	Meat type	SI	Breeder	
				Layer	Dual
Maize	447.5	543.9	594.3	537.6	628.3
Soybean meal 45%	66.74	231.4	159.4	132.5	119.4
Deoiled Rice Bran	450.7	185.6	73.02	209.5	141.0
Dicalcium Phosphate	5.72	8.63	9.02	5.05	6.08
LSP-Powder	13.88	17.41	80.00	80.00	40.00
Stone Grit	0.00	0.00	62.52	20.10	49.08
Salt	2.90	3.06	2.16	3.09	3.14
Sodium bi-carbonate	1.50	1.50	3.00	1.50	1.50
Vitamin Premix	0.50	0.50	1.00	0.50	0.50
Trace Mineral Mixture	1.00	1.00	2.00	1.00	1.00
DL-Methionine	1.64	2.23	1.50	1.21	1.46
L-Lysine Hcl	2.19	0.68	1.04	0.63	1.23
L-Threonine	0.00	0.00	1.15	1.47	1.12
L-Tryptophan	0.29	0.00	0.41	0.37	0.51
L Arginine	1.88	0.48	2.24	1.84	2.12
Choline Chloride,75%	1.00	1.00	2.00	1.00	1.00
Toxin Binder	1.00	1.00	2.00	1.00	1.00
Coccidiostat	0.50	0.50	1.00	0.50	0.50
Liver Tonic	0.50	0.50	1.00	0.50	0.50
Vit E and Se	0.25	0.25	0.50	0.25	0.25
NSP Enzyme	0.25	0.25	0.50	0.25	0.25
Phytase 5000	0.10	0.10	0.20	0.10	0.10

SI : Semi intensive



Backyard Poultry - Eastern Region

Table 64. Feed formulae (kg/ton)

Ingredient	Nursery	Meat type	SI	Breeder	
				Layer	Dual
Maize	287.9	268.1	405.9	380.2	441.9
Rice Broken	150.0	150.0	150.0	150.0	150.0
Wheat Broken	100.0	100.0	100.0	100.0	100.0
Oil-Veg	0.61	28.65	0.00	0.00	0.00
Soybean meal 45%	91.20	228.2	165.4	159.6	117.2
Deoiled Rice Bran	250.0	100.0	0.00	6.84	25.14
Til cake / Sesame Meal	40.00	40.00	40.00	40.00	40.00
Rapeseed meal	40.00	40.00	40.00	40.00	40.00
Dicalcium Phosphate	12.43	15.11	22.20	11.74	12.43
LSP-Powder	13.15	16.76	59.94	40.00	40.00
Stone Grit	0.00	0.00	0.00	58.65	18.53
Salt	2.56	2.65	2.75	2.75	2.74
Sodium bi-carbonate	1.50	1.50	1.50	1.50	1.50
Vitamin Premix	0.50	0.50	0.50	0.50	0.50
Trace Mineral Mixture	1.00	1.00	1.00	1.00	1.00
DL-Methionine	1.84	2.30	1.58	1.38	1.44
L-Lysine Hcl	2.77	1.45	2.24	1.14	2.01
L-Threonine	0.52	0.55	3.25	0.69	1.06
L-Tryptophan	0.03	0.00	0.00	0.09	0.28
L Arginine	0.78	0.00	0.46	0.67	1.06
Choline Chloride,75%	1.00	1.00	1.00	1.00	1.00
Toxin Binder	1.00	1.00	1.00	1.00	1.00
Coccidiostat	0.50	0.50	0.50	0.50	0.50
Liver Tonic	0.50	0.50	0.50	0.50	0.50
Vit E and Se	0.25	0.25	0.25	0.25	0.25

SI : Semi intensive



Backyard Poultry - Eastern Region

Table 65. Feed formulae (kg/ton) with Enzymes

Ingredient	Nursery	Meat type	SI	Breeder	
				Layer	Dual
Maize	251.0	344.2	395.9	330.2	418.1
Rice Broken	150.0	150.0	150.0	150.0	150.0
Wheat Broken	100.0	100.0	100.0	100.0	100.0
Soybean meal 45%	27.60	185.9	137.0	90.16	72.93
Deoiled Rice Bran	350.0	100.0	2.04	128.4	68.66
Til cake / Sesame Meal	40.00	40.00	40.00	40.00	40.00
Rapeseed meal	40.00	40.00	40.00	40.00	40.00
Dicalcium Phosphate	5.11	7.97	15.25	4.35	5.35
LSP-Powder	19.84	17.16	103.86	40.00	40.00
Stone Grit	0.00	0.00	0.00	62.49	48.83
Salt	2.76	2.90	2.76	2.68	2.72
Sodium bi-carbonate	1.50	1.50	1.50	1.50	1.50
Vitamin Premix	0.50	0.50	0.50	0.50	0.50
Trace Mineral Mixture	1.00	1.00	1.00	1.00	1.00
DL-Methionine	1.47	2.12	1.43	0.97	1.21
L-Lysine Hcl	3.02	1.78	2.12	1.42	2.09
L-Threonine	0.44	0.51	1.67	0.61	0.99
L-Tryptophan	0.26	0.10	0.00	0.32	0.48
L Arginine	1.87	0.85	1.39	1.77	2.10
Choline Chloride,75%	1.00	1.00	1.00	1.00	1.00
Toxin Binder	1.00	1.00	1.00	1.00	1.00
Coccidiostat	0.50	0.50	0.50	0.50	0.50
Liver Tonic	0.50	0.50	0.50	0.50	0.50
Vit E and Se	0.25	0.25	0.25	0.25	0.25
Enzyme	0.25	0.21	0.25	0.25	0.25
Phytase 5000	0.10	0.10	0.10	0.10	0.10

SI : Semi intensive



Backyard Poultry - Northern Region

Table 66. Feed formulae (kg/ton)

Ingredient	Nursery	Meat type	SI	Breeder	
				Layer	Dual
Maize	124.8	291.1	283.8	364.5	327.8
Rice Broken	150.0	150.0	150.0	150.0	150.0
Wheat Broken	100.0	100.0	100.0	100.0	100.0
Bajra	150.0	0.00	150.0	0.00	150.0
Oil-Veg	10.93	24.32	0.00	0.00	0.00
Soybean meal 45%	95.15	209.1	146.7	118.3	104.0
Deoiled Rice Bran	250.0	100.0	2.51	84.30	3.54
Rapeseed meal	40.00	40.00	40.00	40.00	40.00
Guar Meal	40.00	40.00	40.00	40.00	40.00
Dicalcium Phosphate	14.73	15.97	22.82	12.30	13.18
LSP-Powder	11.01	16.02	49.73	40.00	40.00
Stone Grit	0.00	0.00	0.00	38.03	17.58
Salt	2.50	2.70	2.68	2.75	2.69
Sodium bi-carbonate	1.50	1.50	1.50	1.50	1.50
Vitamin Premix	0.50	0.50	0.50	0.50	0.50
Trace Mineral Mixture	1.00	1.00	1.00	1.00	1.00
DL-Methionine	1.67	2.45	1.53	1.35	1.47
L-Lysine Hcl	2.65	1.52	2.25	1.35	2.03
L-Threonine	0.27	0.56	1.74	0.68	1.07
L-Tryptophan	0.00	0.00	0.00	0.18	0.23
L Arginine	0.00	0.00	0.00	0.00	0.15
Choline Chloride,75%	1.00	1.00	1.00	1.00	1.00
Toxin Binder	1.00	1.00	1.00	1.00	1.00
Coccidiostat	0.50	0.50	0.50	0.50	0.50
Liver Tonic	0.50	0.50	0.50	0.50	0.50
Vit E and Se	0.25	0.25	0.25	0.25	0.25

SI : Semi intensive



Backyard Poultry - Northern Region

Table 67. Feed formulae (kg/ton) with Enzymes

Ingredient	Nursery	Meat type	SI	Breeder	
				Layer	Dual
Maize	125.5	220.0	275.6	216.1	253.9
Rice Broken	150.0	150.0	150.0	150.0	150.0
Wheat Broken	100.0	100.0	100.0	100.0	100.0
Bajra	150.0	150.0	150.0	150.0	150.0
Oil-Veg	0.0	0.571	0.00	0.00	0.00
Soybean meal 45%	8.313	160.5	115.9	77.02	11.69
Guar Meal	40.00	40.00	40.00	40.00	40.00
Rapeseed meal	40.00	40.00	40.00	40.00	41.00
Deoiled Rice Bran	350.0	100.0	0.00	106.8	196.2
Dicalcium Phosphate	5.79	8.73	15.95	5.10	5.50
LSP-Powder	15.221	16.322	96.77	40.00	37.34
Stone Grit	0.00	0.00	0.00	61.54	0.00
Salt	2.44	2.60	2.70	2.63	2.56
Sodium bi-carbonate	1.50	1.50	1.50	1.50	1.50
Trace Mineral Mixture	1.00	1.00	1.00	1.00	1.00
Vitamin Premix	0.50	0.50	0.50	0.50	0.50
DL-Methionine	1.45	2.09	1.53	1.0	0.89
L-Lysine Hcl	3.08	1.87	2.26	1.44	2.50
L-Threonine	0.45	0.51	2.14	0.61	0.97
L-Tryptophan	0.22	0.10	0.00	0.28	0.49
L Arginine	0.97	0.14	0.55	0.86	1.30
Choline Chloride,75%	1.00	1.00	1.00	1.00	1.00
Vit E and Se	0.25	0.25	0.25	0.25	0.25
Toxin Binder	1.00	1.00	1.00	1.00	1.00
Coccidiostat	0.50	0.50	0.50	0.50	0.50
Liver Tonic	0.50	0.50	0.50	0.50	0.50
NSP Enzyme	0.25	0.25	0.25	0.25	0.25
Phytase 5000	0.10	0.10	0.10	0.10	0.10

SI : Semi intensive



Backyard Poultry - Southern Region

Table 68. Feed formulae (kg/ton)

Ingredient	Nursery	Meat type	SI	Breeder	
				Layer	Dual
Maize	60.32	309.2	363.1	206.4	393.0
Rice Broken	150.0	100.0	100.0	150.0	115.9
Sorghum	150.0	50.00	100.0	150.0	100.0
Ragi	150.0	50.00	100.0	150.0	100.0
Oil-Veg	18.65	29.57	0.00	0.00	0.00
Soybean meal 45%	59.81	193.8	122.8	119.2	87.52
Deoiled Rice Bran	250.0	100.0	0.00	3.23	0.00
Til cake / Sesame Meal	20.00	20.00	20.00	20.00	20.00
Sunflower meal	20.00	20.00	20.00	20.00	20.00
Cotton Seed Meal 42%	40.00	40.00	40.00	40.00	40.00
Groundnut meal	40.00	40.00	40.00	40.00	40.00
Dicalcium Phosphate	12.72	15.60	22.60	11.93	12.86
LSP-Powder	13.29	17.10	50.92	40.00	40.00
Stone Grit	0.00	0.00	0.00	35.61	15.48
Salt	2.17	2.63	2.58	2.35	2.56
Sodium bi-carbonate	1.50	1.50	1.50	1.50	1.50
Vitamin Premix	0.50	0.50	0.50	0.50	0.50
Trace Mineral Mixture	1.00	1.00	1.00	1.00	1.00
DL-Methionine	2.21	2.68	3.28	1.70	1.84
L-Lysine Hcl	3.77	2.49	3.55	2.34	3.06
L-Threonine	0.81	0.69	5.00	0.97	1.26
L-Tryptophan	0.02	0.00	0.00	0.11	0.33
Choline Chloride,75%	1.00	1.00	1.00	1.00	1.00
Toxin Binder	1.00	1.00	1.00	1.00	1.00
Coccidiostat	0.50	0.50	0.50	0.50	0.50
Liver Tonic	0.50	0.50	0.50	0.50	0.50
Vit E and Se	0.25	0.25	0.25	0.25	0.25

SI : Semi intensive



Backyard Poultry - Southern Region

Table 69. Feed formulae (kg/ton) with Enzymes

Ingredient	Nursery	Meat type	SI	Breeder	
				Layer	Dual
Maize	88.49	387.0	309.6	178.6	342.0
Rice Broken	150.0	100.0	100.0	150.0	150.0
Sorghum	150.0	50.00	100.0	150.0	100.0
Ragi	150.0	50.00	100.0	150.0	100.0
Soybean meal 45%	2.97	145.5	67.62	71.20	47.09
Deoiled Rice Bran	300.0	100.0	120.7	58.32	29.84
Til cake / Sesame Meal	20.00	20.00	20.00	20.00	20.00
Sunflower meal	20.00	20.00	20.00	20.00	20.00
Cotton Seed Meal 42%	40.00	40.00	40.00	40.00	40.00
Groundnut meal	40.00	40.00	40.00	40.00	40.00
Dicalcium Phosphate	5.50	8.53	15.04	4.80	5.82
LSP-Powder	16.78	23.48	51.37	40.00	40.00
Stone Grit	0.00	0.00	0.00	62.60	49.02
Salt	2.14	2.64	2.50	2.33	2.51
Sodium bi-carbonate	1.50	1.50	1.50	1.50	1.50
Vitamin Premix	0.50	0.50	0.50	0.50	0.50
Trace Mineral Mixture	1.00	1.00	1.00	1.00	1.00
DL-Methionine	1.91	2.48	1.43	1.45	1.64
L-Lysine Hcl	4.08	2.84	3.35	2.45	3.10
L-Threonine	0.73	0.64	1.75	0.90	1.22
L-Tryptophan	0.25	0.24	0.00	0.32	0.51
L Arginine	0.54	0.00	0.00	0.43	0.65
Choline Chloride,75%	1.00	1.00	1.00	1.00	1.00
Toxin Binder	1.00	1.00	1.00	1.00	1.00
Coccidiostat	0.50	0.50	0.50	0.50	0.50
Liver Tonic	0.50	0.50	0.50	0.50	0.50
Vit E and Se	0.25	0.25	0.25	0.25	0.25
NSP Enzyme	0.25	0.25	0.25	0.25	0.25
Phytase 5000	0.10	0.10	0.10	0.10	0.10

SI : Semi intensive



Backyard Poultry - Western Region

Table 70. Feed formulae (kg/ton)

Ingredient	Nursery	Meat type	SI	Breeder	
				Layer	Dual
Maize	240.9	220.6	355.8	320.6	404.8
Rice Broken	150.0	150.0	150.0	150.0	150.0
Sorghum	150.0	150.0	150.0	150.0	150.0
Oil-Veg	2.24	30.61	0.00	0.00	0.00
Soybean meal 45%	55.83	192.25	155.2	106.6	85.85
Deoiled Rice Bran	250.0	100.0	3.96	58.73	9.69
Coconut Cake	0.00	0.00	40.00	0.00	0.00
Cotton Seed Meal 42%	40.00	40.00	40.00	40.00	40.00
Rapeseed meal	30.00	30.00	30.00	30.00	30.00
Groundnut meal	40.00	40.00	0.00	40.00	40.00
Dicalcium Phosphate	12.92	15.61	22.15	12.01	12.97
LSP-Powder	13.02	16.63	38.19	40.00	40.00
Stone Grit	0.00	0.00	0.00	38.66	21.70
Salt	2.33	2.42	2.53	2.48	2.52
Sodium bi-carbonate	1.50	1.50	1.50	1.50	1.50
Vitamin Premix	0.50	0.50	0.50	0.50	0.50
Trace Mineral Mixture	1.00	1.00	1.00	1.00	1.00
DL-Methionine	2.28	2.76	1.82	1.70	1.92
L-Lysine Hcl	3.48	2.18	2.40	2.00	2.70
L-Threonine	0.68	0.72	1.67	0.84	1.22
L-Tryptophan	0.12	0.00	0.00	0.20	0.36
Choline Chloride,75%	1.00	1.00	1.00	1.00	1.00
Toxin Binder	1.00	1.00	1.00	1.00	1.00
Coccidiostat	0.50	0.50	0.50	0.50	0.50
Liver Tonic	0.50	0.50	0.50	0.50	0.50
Vit E and Se	0.25	0.25	0.25	0.25	0.25

SI : Semi intensive

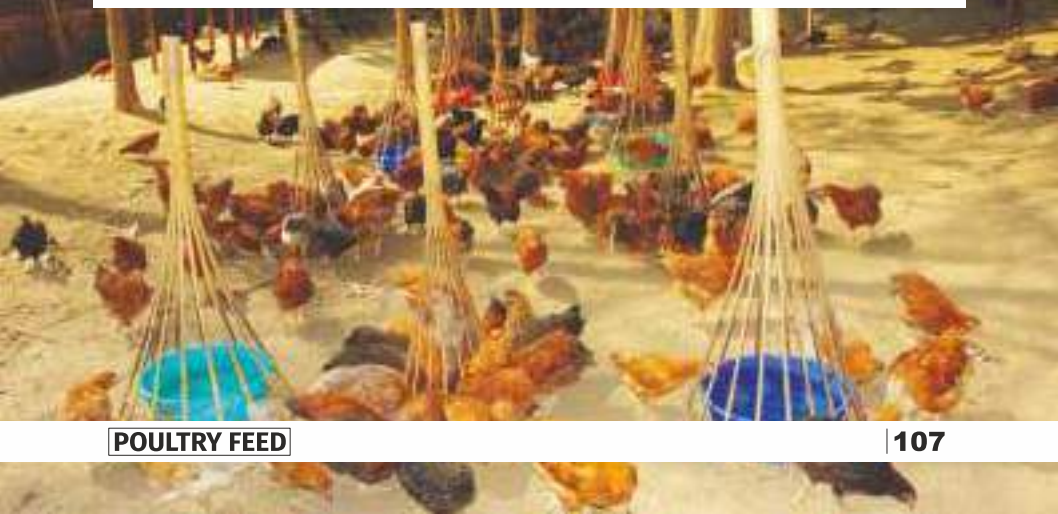


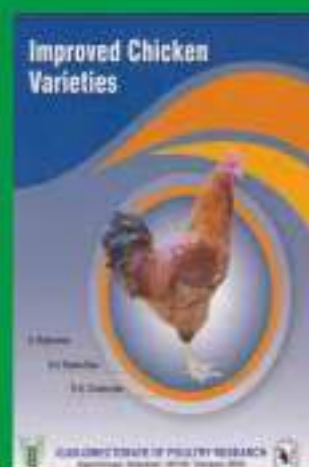
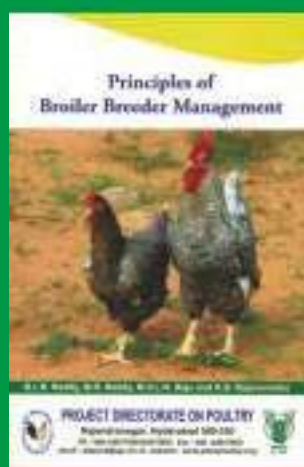
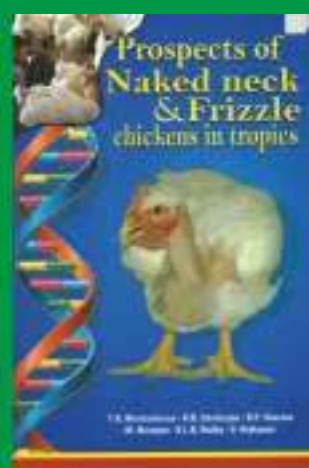
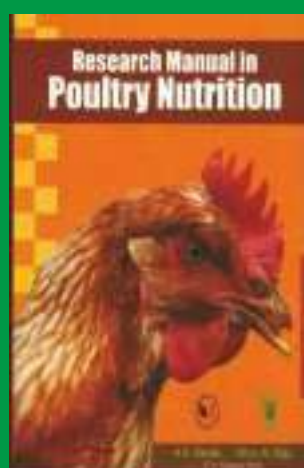
Backyard Poultry - Western Region

Table 71. Feed formulae (kg/ton) with Enzymes

Ingredient	Nursery	Meat type	SI	Breeder	
				Layer	Dual
Maize	193.1	309.7	348.0	290.0	377.6
Rice Broken	150.0	150.0	150.0	150.0	150.0
Sorghum	150.0	150.0	150.0	150.0	150.0
Oil-Veg	5.22	0.00	0.00	0.00	0.00
Soybean meal 45%	7.14	138.7	125.5	55.83	38.43
Deoiled Rice Bran	350.0	100.0	0.62	122.36	63.10
Coconut Cake	0.00	0.00	40.00	0.00	0.00
Cotton Seed Meal 42%	40.00	40.00	40.00	40.00	40.00
Rapeseed meal	30.00	30.00	30.00	30.00	30.00
Groundnut meal	40.00	40.00	0.00	40.00	40.00
Dicalcium Phosphate	5.45	8.56	15.27	5.44	5.85
LSP-Powder	13.41	17.08	85.23	40.00	40.00
Stone Grit	0.00	0.00	0.00	61.94	48.69
Salt	2.27	2.67	2.55	2.45	2.49
Sodium bi-carbonate	1.50	1.50	1.50	1.50	1.50
Vitamin Premix	0.50	0.50	0.50	0.50	0.50
Trace Mineral Mixture	1.00	1.00	1.00	1.00	1.00
DL-Methionine	1.98	2.68	1.72	1.43	1.67
L-Lysine Hcl	3.68	2.90	2.37	2.13	2.80
L-Threonine	0.62	0.83	1.62	0.76	1.15
L-Tryptophan	0.26	0.25	0.00	0.41	0.57
L Arginine	0.34	0.08	0.52	0.67	1.00
Choline Chloride,75%	1.00	1.00	1.00	1.00	1.00
Toxin Binder	1.00	1.00	1.00	1.00	1.00
Coccidiostat	0.50	0.50	0.50	0.50	0.50
Liver Tonic	0.50	0.50	0.50	0.50	0.50
Vit E and Se	0.25	0.25	0.25	0.25	0.25
NSP Enzyme	0.15	0.20	0.25	0.25	0.25
Phytase 5000	0.10	0.10	0.10	0.10	0.10

SI : Semi intensive







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