

PHILLIPINE NATIONAL STANDARD



Animal Feed Ingredients



Animal Feed Ingredients

Foreword

This Philippine National Standard (PNS) on Animal Feed Ingredients aims to provide guidelines for the quality and safety of feed ingredients used in animal feeds intended for domesticated livestock and poultry animals.

The formulation of this Philippine National Standards (PNS) on Animal Feed Ingredients was drafted and reviewed by the BAFS Technical Working Group prior to its presentation for public consultations in Quezon City, Cebu, Davao, and Cagayan de Oro with the major stakeholders of animal feed industry. Comments from the stakeholders were carefully evaluated and inputted accordingly in this standard.

The Technical Working Group created by BAFS for this purpose (as per Special Order No. 274), is composed of experts from the Animal Feeds Standardization Division of the Bureau of Animal Industry, Philippine Society of Animal Nutritionists, Philippine Association of Feed Millers, Inc, and Animal and Dairy Sciences Cluster of the University of the Philippines, Los Baños.

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1 Scope

This standard applies to quality and safety parameters of feed ingredients, including their classification, descriptions and purchase specifications, being used in animal feeds intended for domesticated livestock and poultry animals.

2 References

The title of the standard publications and other references of this Code are listed on the back.

3 Definition of Terms

3.1 Feed is any single or multiple materials, whether processed, semi-processed or raw, which is intended to be fed directly to domesticated animals to meet the nutrient requirements in order to maintain life, promote growth, production and reproduction without any additional substance except water.

3.2 Feed Additive refers to an ingredient or combination of ingredients which is added to the basic mixed feed to fulfill a specific need which include, but not limited to, acidifiers, antioxidants, aromatics, deodorizing agents, flavor enhancers, mold inhibitors, pellet binders, preservatives, sweeteners, toxin binders, etc. It is usually used in micro quantities and requires careful handling and mixing. A feed additive may have no nutritive value but is added to the feed to improve its quality and efficacy.

3.3 Feed Ingredient is a component part or constituent of any combination or mixture making up a feed, whether or not it has a nutritional value in the animal's diet, including feed supplements and additives. Ingredients are of plant, animal or aquatic origin, or other organic or inorganic substances.

3.4 Feed Supplement refers to a feed ingredient or mixture of feed ingredients intended to supply the deficiencies in a ration or improve the nutritive balance or performance of the total mixture. For purposes of this standard, the following, such as but not limited to amino acids, fatty acids, vitamins and minerals are considered as feed supplements.

4 Classification of Feed Ingredients**4.1 Energy Sources****4.2 Protein Sources****4.2.1 Animal and Marine Protein****4.2.2 Plant Protein****4.3 Non-Protein Nitrogen Sources**

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4.4 Milling and Factory By-products**4.5 Dairy Products****4.6 Fats and Oils****4.7 Feed Supplements****4.7.1 Mineral Supplements****4.7.1.1 Macro Mineral Supplements****4.7.1.2 Trace Mineral Supplements****4.7.2 Vitamin Supplements****4.7.2.1 Fat Soluble Vitamins****4.7.2.2 Water Soluble Vitamins****4.7.3 Amino Acid Supplements****4.8 Feed Additives****5 Minimum Requirements of Commercial Feed Ingredients****5.1 Energy Sources**

Below are the commonly used feed ingredients under this classification:

5.1.1 Banana (*Musa sapientum*) Meal, Peeled

It is the product obtained by chopping, drying, and grinding of peeled banana fruit. This should have dusty texture, pasty and sticky when wet, off-white to light brown color and fresh odor. The specifications should include:

Moisture	Max 13.0%
Ash	Max 2.0 %
Crude Fiber	Max 5.0%
Starch	Min 50.0%

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5.1.2 Banana (*Musa sapientum*) Meal, Unpeeled

It is the product obtained by chopping, drying, and grinding of unpeeled banana fruit. This should have dusty texture, pasty and sticky when wet, light brown to tan color with brown specks and fresh odor. The specifications should include:

Moisture	Max 12.0%
Ash	Max 6.0%
Crude Fiber	Max 10.0%
Starch.....	Min 40.0%

5.1.3 Barley (*Hordeum vulgare*), Hulled

It is a whole grain that is spindle-shaped in five angles and possessed a broad shallow groove on the ventral side. This should be light gray to tannish gray in color and should be fresh and free from mustiness. The specifications should include:

Moisture	Max 12.0%
Empty grains	Max 2.0%
Impurities	Max 3.0%
Starch	Min 45.0%

5.1.4 Cassava (*Manihot esculenta*) Meal/Chips, Peeled

It is the product obtained by peeling, chopping, drying, and grinding of cassava tubers that is dusty when dry and sticky when wet. This should be white to off-white in color and should be sweet and free from mustiness in odor. The specifications should include:

Moisture	Max 13.0%
Ash	Max 3.0%
Crude Fiber	Max 3.0 %
Impurities	Max 2.0%
HCN*.....	Max 15.0 mg/kg

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Starch Min 60.0%

**Hydrocyanic Acid*

5.1.5 Cassava (*Manihot esculenta*) Meal/Chips, Unpeeled

It is the product obtained by chopping, drying, and grinding of whole cassava tubers that is dusty when dry and sticky when wet. This should be brownish white in color and have fresh odor. The specifications should include:

Moisture Max 13.0%

Ash..... Max 7.0%

Crude Fiber..... Max 6.0%

Impurities Max 2.0%

HCN* Max 30.0 mg/kg

Starch Min 50.0%

**Hydrocyanic Acid*

5.1.6 Corn (*Zea maize*)

A tooth-shaped kernel composed of bran, coat, endosperm and embryo of germ. The color should be white, yellow or in variety and should have a sweet odor free from mustiness. This should be free from infestation. The specifications should include:

Moisture Max 13.0%

Spoiled and damaged grains .. Max 3.0%

Broken grains..... Max 2.0%

Impurities Max 2.0%

Starch Min 60.0%

5.1.7 Wheat Flour, Feed Grade

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It is a product resulting from downgrading food grade flour. It is off-white to cream in color, with characteristic smell of freshly milled flour with traces of wheat hulls. This should be free from infestation. The specifications should include:

Moisture	Max 12.0%
Ash.....	Max 1.0%
Crude protein.....	Min 10.0%
Starch.....	Min 84.0%

5.1.8 Oats (*Avena sativa*)

These are seeds that are usually rolled or flaked to enhance digestibility. They should smell fresh and free from mustiness. This should be free from infestation. The specifications should include:

Moisture	Max 13.0%
Spoiled and Damaged grains...	Max 3.0%
Impurities	Max 2.0%
Crude fiber.....	Max 12.0%
Starch.....	Min 35.0%

5.1.9 Rice (*Oryza sativa*) Middlings

Rice middlings/broken rice are small fragments of rice kernels with traces of awn (“mata-mata”) that have been separated from larger kernels during rice milling. Whole rice kernel may be included. They should be white or brown in color and smell fresh, free from mustiness. This should be free from infestation. The specifications should include:

Moisture	Max 12.0%
Starch	Min 55.0%

5.1.10 Rice (*Oryza sativa*), Paddy or Palay

It is composed of lemma and palea, which have crosshatched markings on the surface and are spinescently hairy. The non-flowering glumes are attached at the base of the paddy and some

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varieties are awned or awnless at the apex. This should be slightly yellow to brown in color, where dark color may indicate off-quality. This should smell fresh and free from mustiness. The specifications should include:

Moisture	Max 12.0%
Ash.....	Max 15.0%
Crude Fiber.....	Max 10.0%
Empty grains	Max 2.0%
Starch.....	Min 45.0%

5.1.11 Sorghum (*Sorghum bicolor*)

It is more or less rounded and bluntly pointed, with a black scar marking the point of its attachment to a stalk at one end and shriveled remains of the two styles at the other end. Color should vary from white, light brown to dark or reddish brown with fresh smell and free from mustiness. The specification should include:

Moisture	Max 12.0%
Empty grains	Max 3.0%
Impurities	Max 2.0%
Tannin	Max 1.0%
Starch	Min 60.0%

5.1.12 Cane Sugar, Brown (Sucrose)

This is unrefined cane sugar that should be brown to golden brown in color and should have fresh and sweet smell, not musty or sour. The specifications should include:

Moisture	Max 5.0%
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5.1.13 Wheat (*Triticum sativa*)

Whole grain of wheat is oval, and blunt at the tip with tuft hairs. Soft wheat should have a tan to light brown color while hard wheat should have brown to reddish brown color. Odor should be fresh and

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free from mustiness. Quality varies depending on the country of origin. The specifications should include:

	Soft	Hard
Moisture	Max 12.0%	Max 12.0%
Crude Protein	Min 9.0%	Min 12.0%
Starch	Min 65.0%	Min 62.0%
Impurities	Max 2.0%	Max 2.0%

5.2 Protein Sources

5.2.1 Animal and Marine Protein Sources

5.2.1.1 Blood Meal/Hemoglobin Powder

It is the coagulated blood which has been dried and ground into a meal that should be reddish black in color and has a characteristic bloody odor. The specifications should include:

Moisture	Max 12.0%
Crude Protein	Min 88.0%
Pepsin Digestibility*	Min 70.0%
<i>Salmonella</i> (at 25 grams).....	Negative

* AOAC, Official Method of Analysis

5.2.1.2 Egg Powder, Whole, Spray dried

These are pasteurized, spray dried whole egg solids that should be cream to light brown in color and with characteristic egg odor. The specifications should include:

	High protein	Low Protein
Moisture	Max 10.0 %	Max 10.0%

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Crude Protein	Min 60.0 %	Min 45.0%
Crude fat	Min 15.0 %	Min 28.0 %
Calcium	Max 0.25%	Max 0.25%
Phosphorus	Max 0.75%	Max 0.75%
<i>Salmonella</i> (at 25 grams).....	Negative	Negative

5.2.1.3 Fish Meal, imported

These are clean, dried, ground tissues of undecomposed fish or fish cuttings, with or without the oil extracted that should be light tan or light brown to reddish brown in color depending on the species of fish with characteristic odor of cooked/dried fish but should not be rancid. The specifications should include:

Moisture	Max 10.0%
Crude Protein	Min 60.0%
Pepsin Digestibility*	Min 70.0%
Crude Fat	Max 12.0%
Salt (NaCl)	Max 4.0%
Calcium	Max 5.0%
Phosphorus.....	Min 3.0%
<i>Salmonella</i> (at 25 grams)	Negative
Histamine.....	Max 500 ppm

*AOAC, Official Method of Analysis

5.2.1.4 Fish Meal, Local

Local fish meals are dried, ground tissues of undecomposed fish or fish cuttings, with or without the oil extracted. This should be light tan or light brown to reddish brown in color and with characteristic odor of cooked/dried fish but should not be rancid. The specifications should include:

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	Min 45% CP	Min 50% CP	Min 55% CP	Min 60% CP
^A Moisture	Max 12.0%	Max 12.0%	Max 12.0%	Max 12.0%
^A Pepsin Digestibility*	Min 60.0%	Min 60.0 %	Min 60.0%	Min 60.0%
^C Crude Fat.....	Max 20.0%	Max 18.0%	Max 15.0%	Max 12.0%
^f Salt (NaCl)	Max 5.0 %	Max 5.0 %	Max 5.0 %	Max 5.0 %
^f Calcium	Max 8.0%	Max 7.0%	Max 6.0%	Max 5.0%
^f Phosphorus	Min 4.5%	Min 3.5%	Min 3.0%	Min 2.5%
^C <i>Salmonella</i> (at 25 grams) ..	Negative	Negative	Negative	negative
^H Histamine	500ppm	500ppm	500ppm	500ppm

* AOAC, Official Method of Analysis

5.2.1.5 Fish Meal Analogue

It is a blend of animal by-products containing feather meal, blood meal, meat and bone meal, poultry by product with or without fishmeal or fish soluble that is brown to dark brown in color and with fresh and meaty but not burnt odor. The specifications should include:

Moisture.....	Max 12.0%
Crude Protein.....	Min 50.0%
Pepsin Digestibility*	Min 35.0%
Salt (NaCl).....	Max 3.0%
Calcium.....	Max 5.0%
Phosphorus.....	Min 3.0%
<i>Salmonella</i> (at 25 grams).....	Negative

*AOAC, Official Method of Analysis

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5.2.1.6 Meat and Bone Meal

These are finely ground, dry rendered tissues and bones, exclusive of hair, hoof and hide trimmings, blood and contents of digestive tract. Color may vary but should be usually grayish brown with fresh and meaty but not burnt smell. The specifications should include:

	Min 45% CP	Min 50% CP	
Moisture	Max 12.0%	Max 12.0%	
Ash	Max 35.0%	Max 27.0%	
Crude Protein	Min 45.0%	Min 50.0%	
Crude Fat	Max 10.0%	Max 10.0%	
Pepsin Digestibility*	Min 60.0%	Min 60.0%	
Salt (NaCl)	Max 3.0%	Max 3.0%	
Calcium	Max 10.0*	Max 8.0%	* AOAC, Official Method of Analysis
Phosphorus	Max 7.0%	Max 5.0%	
<i>Salmonella</i> (at 25 grams)	Negative	Negative	

5.2.1.7 Plasma**Protein**

This is a product separated from blood cells and obtained by the addition of anticoagulant to whole fresh animal blood to prevent clotting. It is dried and ground. Color should be off-white to beige and should be odorless. The specifications should include:

Moisture	Max 12.0%
Crude Protein	Min 70.0%
Pepsin Digestibility*	Min 85.0%
<i>Salmonella</i> (at 25 grams).....	Negative

* AOAC, Official Method of Analysis

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5.2.1.8 Pork/Porcine Meal

It is made from pork/porcine by-products which have been cleaned, ground and rendered. This should be light brown in color with fresh fried meat smell. The specifications should include:

	Min 45% CP	Min 50% CP	Min 60% CP
Moisture	Max 6.0 %	Max 6.0 %	Max 6.0 %
Ash	Max 35.0 %	Max 33.0 %	Max 23.0 %
Pepsin Digestibility*	Min 60.0 %	Min 60.0%	Min 65.0%
Crude Fat	Max 6.0%	Max 6.0%	Max 8.0%
Calcium	Max 15.0 %	Max 12.0 %	Max 10.0 %
Phosphorus	Min 7.0 %	Min 6.0 %	Min 4.0 %
Salmonella (at 25 grams)	Negative	Negative	Negative
NPN**	Negative	Negative	Negative

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*AOAC, Official Method of Analysis

** Non Protein Nitrogen

5.2.1.9 Poultry By-product Meal

These are dried, ground tissues of undecomposed necks, heads, fats, carcass, and traces of feathers of poultry with or without the oil extracted. This should be tan or light brown to reddish brown in color with fresh and meaty but not burnt smell. This should be free from any evidence of scorching and over heating or presence of foul odor. The specifications should include:

Moisture	Max 12.0%
Crude Protein	Min 50.0%
Pepsin Digestibility*	Min 40.0%
Crude Fat	Max 17.0%
Calcium	Max 5.0%
Phosphorus	Min 2.0%
<i>Salmonella</i> (at 25 grams).....	Negative

*AOAC, Official Method of Analysis

5.2.1.10 Hydrolyzed Feather meal

This is the product resulting from the treatment under pressure of clean, undecomposed feathers from slaughtered poultry and free of additives. The specifications should include:

Moisture.....	Max 12.0%
Crude Protein	Min 70.0 %
Pepsin Digestibility*	Min 30.0%

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Salmonella (at 25 grams) Negative

* AOAC, Official Method of Analysis

5.2.1.11 Poultry Meal

These are ground, rendered and dried tissues of undecomposed meat and bone of poultry. The color may vary but should be usually grayish brown with fresh and meaty but not burnt odor. This should be free from any evidence of scorching and over heating or presence of foul odor, as well as free of feathers. The specifications should include:

Moisture	Max 12.0%
Crude Protein	Min 50.0%
Pepsin Digestibility*	Min 50.0%
Crude Fat	Max 15.0%
Calcium	Max 5.0%
Phosphorus	Min 3.0%
<i>Salmonella</i> (at 25 grams).....	Negative

* AOAC, Official Method of Analysis

5.2.1.12 Shrimp Meal

This is by-product of shrimp processing and contains either the exoskeleton or whole shrimp that should be pink or orange in color and with characteristic smell of cooked/dried shrimp. The specifications should include:

Moisture	Max 12.0%
Crude Protein	Min 30.0%

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Pepsin Digestibility*	Min 63.0%
Salt (NaCl)	Max 3.0%
Calcium	Max 6.0%
Phosphorus	Min 2.0%
<i>Salmonella</i> (at 25 grams).....	Negative
Histamine	500.0 mg/kg

*AOAC, Official Method of Analysis

5.2.1.13 Squid Meal

This is undecomposed whole, dried and ground squid that should be light brown to black color and has a characteristic smell of cooked/dried squid. The specifications should include:

Moisture	Max 12.0%
Crude Protein	Min 40.0%
Crude Fat	Min 15.0%
Salt (NaCl)	Max 3.0%
<i>Salmonella</i> (at 25 grams)	Negative
NPN*	Negative

*Non Protein Nitrogen

5.2.2 Plant Protein Sources**5.2.2.1 Black Bean (*Phaseolous vulgaris*)**

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A small black variety of the common bean that should be black in color with fresh and nutty smell. This should be free from infestations. The specification should include:

Moisture	Max 12.0%
Crude Protein	Min 20.0%
Crude Fiber	Max 6.0%

5.2.2.2 Canola (*Brassica spp.*) Meal

A by-product after extraction of oil from canola seeds that should be yellow gold in color and have fresh and nutty smell. This should be free from infestations. The specification should include:

Moisture	Max 12.0%
Crude Protein	Min 37.0%
Crude Fiber	Max 12.0%

5.2.2.3 Leucaena /Ipil-ipil(*Leucaena spp.*) Leaf meal

Dried ground *Leucaena* leaves with minimum amount of stems. This should be greenish brown in color with fresh and free from musty odor. This should be free from infestations. The specifications should include:

Moisture	Max 12.0%
Crude Protein	Min 20.0%
Crude Fiber	Max 14.0%
Mimosine	Max 2 ppm

5.2.2.4 Rapeseed (*Brassica napus*) Meal

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A by-product after extraction of oil from rapeseed that should be greenish brown to brown in color and have fresh and nutty smell. This should be free from infestations. The specifications should include:

Moisture	Max 12.0%
Crude Protein	Min 32.0%
Crude Fiber	Max 12.0%

5.2.2.5 Soybean(*Glycine Max*)Oil Meal, Soya or Soybean Meal

These are by-products after extraction of oil from soybean seeds that should be bright yellow to yellowish brown in color and have fresh, sweet and nutty odor. This should be free from infestations. The specifications should include:

	Low Protein	High Protein
Moisture	Max 12.0%	Max 12.0%
Crude Protein	Min 43.0%	Min 46.0%
Crude Fiber	Max 7.0%	Max 4.0%

Protein Solubility in 0.2% KOH.... 73.0 – 88

Urease activity as change in pH .. 0.02 -0.30

Ash Max 7.0%

Anti-caking agent..... Max 1.0%

5.2.2.6 Soybean (*Glycine Max*), Full Fat

These are processed (extrusion, toasting, expansion, microwaving, etc.) soybean seeds with the purpose of removing much of the anti-nutritional factors. It should be light yellow in color and with fresh and nutty smell. This should be free from infestations. The specifications should include:

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Moisture	Max 12.0%
Crude Protein	Min 35.0%
Crude Fat	Min 16.0%
Crude Fiber	Max 8.0%
Protein Solubility in 0.20% KOH..	60.0 – 75.0%
Urease activity as change in pH..	0.02 – 0.30

5.2.2.7 Cowpea (*Vigna sinensis*)

It is a product obtained from drying cowpea seeds that should be brown in color and should be odorless. This is locally called “paayap” or “kibal”. This should be free from infestations. The specifications should include:

Moisture	Max 13.0%
Crude Protein	Min 20.0%
Crude Fiber	Max 4.0%

5.2.2.8 Dunn Peas (*Pisum sativum*)

This has greenish brown, wrinkled outer covering with yellow cotyledons where color should vary from light green to greenish brown and has no odor. This should be free from infestations. The specifications should include:

Moisture.....	Max 10.0 %
Crude Protein.....	Min 18.0%
Crude Fiber	Max 6.0%

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5.2.2.9 Feed Peas (*Pisum sativum*)

Dried peas intended for animal feed that should be grayish green in color and should be odorless. This should be free from infestations. The specifications should include:

Moisture.....	Max 10.0%
Crude Protein.....	Min 22.0%
Crude Fiber	Max 6.0%

5.2.2.10 Green Peas (*Pisum sativum*)

Dried peas intended for animal feed that should be green in color and should be odorless. This should be free from infestations. The specifications should include:

Moisture.....	Max 10.0%
Crude Protein.....	Min 23.0%
Crude Fiber	Max 6.0%

5.2.2.11 Lupins (*Lupinus spp.*)

Dried lupin seeds that should be cream/gray, speckled in color and have fresh and not musty odor. This should be free from infestations. The specifications should include:

Moisture	Max 10.0%
Crude Protein	Min 27.0%
Crude Fiber	Max 12.0%

5.2.2.12 Maple peas (*Lathyrus niger*)

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It is also called black peas or parched peas. Round shaped seeds, either brown or mottled varieties with yellow cotyledons. The color should be brown, black or speckled and should be odorless. This should be free from infestations. The specifications should include:

Moisture	Max 13.0%
Crude Protein	Min 23.0%
Crude Fiber	Max 6.0%

5.2.2.13 Mungbean(*Phaseolus vulgaris*)

This is dried mungbean seed that should be green or yellow in color and should be odorless. This should be free from infestations. The specification should include:

Moisture	Max 13.0%
Crude Protein	Min 20.0%
Crude Fiber	Max 6.0%

5.2.2.14 Pigeon Pea/Kadyos (*Cajanus cajan*)

This is dried whole pigeon pea seed that should be cream in color and should be odorless. This should be free from infestations. The specifications should include:

Moisture	Max 13.0%
Crude Protein	Min 20.0%
Crude Fiber	Max 10.0%

5.2.2.15 Rice Bean/Tapilan (*Phaseolous calcaratus*)

This is dried whole or ground rice bean that should be cream/light brown in color and should be odorless. This should be free from infestations. The specifications should include:

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Moisture	Max 13.0%
Crude Protein	Min 18.0%
Crude Fiber	Max 8.0%

5.2.2.16 Safflower (*Carthamus tinctorius*) Seed

This is dried safflower seed that should be off-white in color and have fresh and nutty odor. This should be free from infestations. The specifications should include:

Moisture	Max 10.0%
Crude Protein	Min 13.0%
Crude Fat	Min 25.0%
Crude Fiber	Max 30.0%

5.2.2.17 Sunflower (*Helianthus annuus*) Seeds

This is dried sunflower seed that commonly should be black with white stripes or plain black. This should be free from infestations. This should be odorless and include the following specifications:

Moisture	Max 10.0%
Crude Protein	Min 16.0%
Crude Fat	Min 30.0%
Crude Fiber	Max 25.0%

5.2.2.18 Vetch (*Vicia sativa*) Seeds/Common vetch

This is pillow shaped seed with a mottled brown seed coat that when split, seed color varies from white/ beige to orange, depending on the variety. This should be odorless and should be free from infestations. The specifications should include:

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Moisture	Max 10.0%
Crude Protein	Min 25.0%
Crude Fiber	Max 5.0%

5.2.2.19 White Peas/Yellow Peas (*Pisum sativum*)

Dried garden peas with wrinkled seed coat at maturity that should be white to yellow in color and should be odorless. This should be free from infestations. The specifications should include:

Moisture	Max 12.0%
Crude Protein	Min 20.0%
Crude Fiber	Max 10.0%

5.2.2.20 Guar Meal

A co-product generated from the production of guar gum, an industrially important commodity being widely used in industries such as food, textile, pharmaceuticals, personal care, health care, nutrition, explosives, mining, and oil drilling. After the extraction of the endosperm, the gum part, the remaining germ & husk form part of guar meal. It should be cream to light brown in color and should be free from burnt odor. This should be free from infestations. The specifications should include:

Moisture.....	Max 7.0%
Crude Protein.....	Min 49.0%
Crude fiber.....	Max 4.0%
Ash.....	Max 6.0%

5.3 Non-protein nitrogen source**5.3.1 Urea**

This is opaque, round or crystal granules containing high amount of nitrogen. This should be white in color and have no characteristic odor. This should be for ruminant use only. The specifications should include:

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Moisture	Max 3.0%
Crude Protein	Min 28.0%

5.4 Milling and Factory By-products**5.4.1 Bakery By-Products**

These are bakery products and by products blended, dried and ground into a meal that should vary from white to dark brown in color and have fresh and not musty or rancid odor. They should not be burnt, moldy or insect-damaged. The specifications should include:

Moisture	Max 10.0%
Salt (NaCl).....	Max 5.0%
Crude Fat	Max 10.0%
Starch.....	Min 35.0%

5.4.2 Cassava Residue Meal/Pellet

This is a by-product of starch production.

Moisture	Max 12.0%
Ash.....	Max 7.0%
Crude Protein.....	Min 7.0%
Fiber.....	Max 13.0%
Impurities	Max 2.0%
HCN.....	Max 50.0 mg/kg
Starch	Min 40.0%

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5.4.3 Dried Spent Brewer's Grain

This is a by-product from the brewing process of barley and other grains that should be light to dark brown in color with dried fermented grain smell. The specifications should include:

Moisture	Max 10.0%
Crude Protein	Min 23.0%
Crude Fiber	Max 17.0%

5.4.4 Dried Brewer's Yeast

This is dried by-product obtained from fermentation of grains that should be pale brown in color and has fermented grain smell. The specifications should include:

Moisture	Max 10.0%
Crude Protein	Min 30.0%
Crude Fiber	Max 16.0%

5.4.5 Copra Cake/Meal

A by-product after extraction of oil from copra that should be light brown to brown in color and have nut-like and pleasant smell, one that resembles roasted coconut not musty, burnt nor rancid odor. This is unpalatable at high inclusion rates and has imbalanced amino acid profile. The specifications should include:

	Expeller	Solvent
Moisture	Max 8.0%	Max 10.0%
Crude Protein	Min 18.0%	Min 20.0%

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Crude Fat	Max 12.0%	Max 10.0%
Crude Fiber	Max 10.0%	Max 12.0%
Salt (NaCl)	Max 1.2%	Max 1.2%

5.4.6 Corn Bran

The outer covering of the corn kernel with some starch that should be off-white to light yellow in color and have fresh and free from musty odor. This should be free from infestation and should include the following specifications:

Moisture	Max 12.0%
Crude Protein	Min 8.0%
Crude Fiber	Max 10.0%

5.4.7 Corn Germ Meal

It is a by-product after oil extraction from corn germ by expeller or solvent processes that should be golden yellow to brown in color and with fresh and nutty smell and not musty or sour. This should be free from infestation. The specifications should include:

	Expeller	Solvent
Moisture	Max 12.0%	Max 12.0%
Crude Protein	Min 13.0%	Min 20.0%
Crude Fat	Min 6.0%	Min 1.0%
Crude Fiber	Max 10.0%	Max 9.0%

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5.4.8 Corn Gluten Feed

It is a by-product in the manufacture of starch from corn by wet-milling process. May consist of corn gluten meal and corn bran with or without corn solubles and corn oil. This should be tan to yellowish brown in color and smell fresh similar to that of toasted cereals blended with a slight trace of dried fermented corn. This should be free from infestations. The specifications should include:

Moisture	Max 12.0%
Crude Protein	Min 16.0%
Crude Fiber	Max 12.0%

5.4.9 Corn Gluten Meal

Dried corn residue after a large part of the starch, germ and bran have been removed that should be golden yellow or brownish-yellow in color and with nutty and not rancid smell. This should be free from infestations. The specifications should include:

Moisture	Max 10.0%
Crude Protein	Min 60.0%
Crude Fiber	Max 3.0%

5.4.10 Dried Distillers Grains with Solubles (DDGS)

A co-product of fermentation of cereals and grains, mostly corn, for the production of alcohol. It is should be bright yellow to light brown in color and should be free of burnt or smoky odor. The specifications should include:

Moisture	Max 12.0%
Crude protein	Min 25.0%
Crude fiber.....	Max 8.0%
Crude fat.....	Max 10.0%

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5.4.11 Sugarcane (*Saccharum officinarum*) Molasses

It is a by-product in the manufacture of cane sugar that should be brown to dark brown in color and should have typical sugar aroma. The specifications should include:

Moisture	Max 25.0%
Brix	Min 78.0 degrees

5.4.12 Palm Kernel Meal

A by-product after extraction of oil from palm kernel that should be light to dark brown in color with fresh and nutty but not musty, burnt nor rancid odor. This should include the following specifications:

Moisture	Max 8.0%
Ash.....	Max 5.0%
Crude Protein	Min 18.0%
Crude Fiber.....	Max 12.0%
Crude Fat	Min 14.0%

5.4.13 Rice Bran, D₁ or Cono

This consists primarily of pericarp or bran layer and germ of rice, with minimal quantity of hulls that should be off-white to light brown in color and with fresh and not rancid or musty odor. This should be free from insect infestations and foreign materials. The specifications should include:

Moisture	Max 10.0%
Ash.....	Max 8.0%
Crude Protein	Min 11.0%
Crude Fiber	Max 7.0%

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Crude Fat..... Min 12.0%

5.4.14 Rice Bran_{D2} or Kiskis

This is also the pericarp or bran layer and germ of rice, but with higher quantity of hulls than Rice Bran _{D1} that should be light brown in color with fresh and not rancid or musty odor. This should be free from insect infestations and foreign materials. The specifications should include:

Moisture Max 12.0%

Ash..... Max 8.0%

Crude Protein Min 9.0%

Crude Fiber Max 12.0%

Crude Fat..... Min 9.0%

5.4.15 Scrap Noodles

These are pasta or rice noodles rejected for human consumption that should be odorless. The specifications should include

	Pasta	Rice noodles
Moisture	Max 5.0%	Max 5.0%
Crude Protein	Min 10.0%	Min 6.0%
Starch	Min 70.0%	Min 70.0%

5.4.16 Soya Hulls

These are by-products after dehulling soybeans that should be light yellow in color with fresh and not musty odor. The specifications should include:

Moisture Max 12.0%

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Crude Protein.....	Min 10.0%
Crude Fiber.....	Max 38.0%

5.4.17 Wheat Gluten

This is by-product in the manufacture of starch from wheat that should be beige in color and no characteristic odor. The specifications should include:

Moisture.....	Max 12.0%
Crude Protein.....	Min 75.0%

5.4.18 Wheat Pollard

This is by-product of wheat milling. It is the portion of wheat between the skin or the bran and endosperm. It may either be soft or hard depending on the variety of wheat. The soft pollard should be light brown in color while hard pollard should be light reddish brown color. Both should smell fresh and not musty. This should be free from insect infestations and should have the following specifications:

	Soft	Hard
Moisture.....	Max 13.0%	Max 13.0%
Crude Protein	Min 14.0%	Min 16.0%
Crude Fiber	Max 10.0%	Max 11.0%

5.5 Dairy Products

5.5.1 Buttermilk Powder

It is by-product in the production of butter that should be yellowish white to cream in color with a characteristic odor of sour milk. This should not contain burnt particles. The specifications should include:

Moisture	Max 10.0%
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Animal Feed Ingredients

Ash.....	Max 11.0%
Crude Protein.....	Min 30.0%
Crude Fat.....	Min 5.0 %
<i>Salmonella</i> (at 25 grams).....	Negative

5.5.2 Lactose Powder

This is milk sugar where its sweetness is only about 1/5 of the sweetness of ordinary sugar. This should be off-white in color with fresh and milky smell. The specifications should include:

Moisture	Max 1.0%
Lactose.....	Min 98.0%
<i>Salmonella</i> (at 25 grams).....	Negative

5.5.3 Skimmed Milk Powder

It is a product resulting from the removal of water and fats from clean milk. This should be white or cream in color with fresh and milky smell. The specifications should include:

Moisture	Max 6.0%
Protein	Min 33.0%
Calcium.....	Max 1.5%
Phosphorous	Min 0.8%
Lactose	Min 40.0%
<i>Salmonella</i> (at 25 grams).....	Negative

5.5.4 Skimmed Milk Replacer

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It is a replacer for a regular skimmed milk that contains vegetable protein and lactose. The specifications should include:

Moisture	Max 6.0%
Protein	Min 25.0%
Calcium.....	Max 1.5%
Phosphorous	Min 0.8%
Lactose	Min 20.0%
<i>Salmonella</i> (at 25 grams).....	Negative

5.5.5 Whey Powder, Sweet

It is the portion of milk which remains after most of the casein and fat have been removed for the manufacture of cheese. This should be white or cream in color with fresh and milky smell. The specifications should include:

Moisture	Max 6.0%
Ash	Max 8.5%
Crude Protein	Min 11.0%
Salt	Max 3.5%
Lactose	Min 65.0%
<i>Salmonella</i> (at 25 grams).....	Negative

5.5.6 Whey powder, deproteinized

It is the product which results from the removal of protein from whey. The color should be off-white to cream. The specifications should include the following:

Animal Feed Ingredients

Moisture	Max 6.0%
Ash	Max 11.0%
Crude Protein	Min 2.0%
Salt	Max 3.5%
Lactose	Min 80.0%
<i>Salmonella</i> (at 25 grams).....	Negative

5.5.7 Whole Milk Powder

It is a product obtained by drying milk that should be white in color, have fresh and milky odor. The specifications should include:

Moisture	Max 7.0%
Crude Protein	Min 20.0%
Crude Fat	Min 20.0%
Calcium.....	Max 1.0%
Phosphorous.....	Min 1.0%
Lactose	Min 45.0%
<i>Salmonella</i> (at 25 grams)	Negative

5.6 Fats and Oils**5.6.1 Acidulated Oil or Acid Oil**

It is acid-treated by-product in the refining of crude coco oil that should be dark brown in color and have acidic but not rancid odor. This should be free from foreign materials. The specifications should include:

Moisture	Max 5.0%
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Animal Feed Ingredients

Total free fatty acid	
as Lauric	Max 60.0%
as Oleic	Max 65.0%
Peroxide value.....	Max 10 meq/kg

5.6.2 Coconut Oil

It is crude or refined oil extracted from coconut meat using solvent or expeller process that should be clear liquid, dark yellow to golden yellow in color, has fresh and not rancid odor. The specifications should include:

Moisture	Max 2.0%
Total free fatty acid	
as Lauric	Max 5.0%
as Oleic	Max 7.0%
Peroxide Value	Max 5.0 meq/kg
Iodine Value	Max 10.0g iodine per100 g oil

5.6.3 Fish Oil

It is oil obtained from fish cannery that should be pale yellow in color and have fishy odor but not rancid. The specifications should include:

Moisture	Max 2.0%
Total free fatty acid	
as Lauric	Max 5.0%
as Oleic	Max 7.0%
Peroxide Value	Max 7.0 meq/kg
Iodine Value	110-120 g iodine per 100 g oil

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Salmonella(at 25 grams)..... Negative

5.6.4 Palm Kernel Oil, crude

It is crude oil extracted from palm nuts using solvent or expeller process. This should be reddish brown in color and have fresh but not rancid or musty odor. The specifications should include:

Moisture	Max 2.0%
Total free fatty acid, as Palmitic...	Max 5.0%
Peroxide Value	Max 7.0 meq/kg
Iodine Value	Max 23.0 g iodine per 100 g oil

5.6.5 Palm Oil, crude

It is crude oil extracted from palm fruit using solvent or expeller process. This is dark orange in color and has fresh but not rancid or musty odor. The specifications should include:

Moisture	Max 2.0%
Total free fatty acid, as Palmitic...	Max 6.0%
Peroxide value	Max 10.0meq/kg
Iodine Value	Max 55.0 g iodine per 100 g oil

5.6.6 Palm Olein

It is fractionated palm oil. This is light orange in color and has fresh but not rancid or musty odor. The specifications should include:

Moisture	Max 2.0%
Total free fatty acid, as Palmitic...	Max 6.0%

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Peroxide value	Max 7.0 meq/kg
Iodine value	Max 55.0 g Iodine per 100 g oil

5.6.7 Soybean Oil

It is crude or refined oil extracted from soybean seeds using solvent or expeller process. This should have brownish yellow color and fresh and not rancid or musty odor. The specifications should include:

Moisture	Max 2.0%
Total free fatty acid, as Oleic	Max 6.0%
Peroxide Value	Max 7.0 meq/kg
Iodine Value (number).....	Max 141.0 g iodine per 100 g oil

5.6.8 Tallow

It is by-product of the rendering process of fat from cattle, carabao and sheep that should be white to off-white in color and have fresh and not rancid or musty odor. This requires heating before mixing to the feeds and is solid at room temperature. The specifications should include:

Moisture	Max 2.0%
Total free fatty acid, as Butyric ...	Max 5.0%
Peroxide Value	Max 7.0 meq/kg
Iodine Value (number.)	Min 38.0 g iodine per 100 g oil

5.6.9 Cooking Oil, Used

This is residual oil after frying food products that should be yellow to brown in color and have burnt oil smell. The specifications should include:

Animal Feed Ingredients

Moisture	Max 2.0%
Total free fatty acid	
as Lauric	Max 20.0%
as Oleic	Max 25.0%
Peroxide Value	Max 7.0 meq/kg

5.7 Feed Supplements and Additives

5.7.1 Mineral Supplements

5.7.1.1 Macro Mineral Supplements

5.7.1.1.1 Calcium and Phosphorous Sources

5.7.1.1.1.1 Bone Meal, Steamed

It is by-product of meat processing composed of bones sterilized by cooking with steam under pressure, dried and ground. This should be light tan to gray in color and have cooked meat and bone odor. The specifications should include:

Moisture	Max 10.0%
Calcium	Max 30.0%
Phosphorus	Min 12.0%
<i>Salmonella</i> (at 25 grams).....	Negative

5.7.1.1.1.2 Dicalcium Phosphate, or Dicaphos

Dicalcium phosphate is a calcium salt of phosphoric acid. This should be beige to light gray in color and have no characteristic odor. The specifications should include:

Animal Feed Ingredients

Calcium	Max 24.0%
Phosphorus	Min 18.0%
Fluorine	Max 0.2%

5.7.1.1.1.3 Monocalcium Phosphate, or Monodical [Ca (H₂PO₄)₂.H₂O]

Monodical is a blend of dicalcium phosphate and monocalciumphosphate that should be beige to light gray in color and should have no characteristic odor. The specifications should include:

Calcium	Max 20.0%
Phosphorus	Min 21.0%
Fluorine	Max 0.2%

5.7.1.1.1.4 Monocalcium Phosphate CaH₄O₈P₂

Monocalciumphosphate is a calcium salt of phosphoric acid. This should be beige to light gray in color and have no characteristic odor. The specifications should include:

Calcium	Max 16.0%
Phosphorus	Min 22.0%
Fluorine	Max 0.2%

5.7.1.1.1.5 Tricalcium Phosphate or Tricaphos (Ca₃O₈P₂)

This is the product obtained by heating rock phosphate deposits where color should vary from grayish tan to brownish red and should have no characteristic odor. This should be free from foreign materials. The specifications should include:

Calcium	Max 24.0%
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Animal Feed Ingredients

Phosphorus Min 11.0%

Fluorine Max 0.2%

5.7.1.1.2 Calcium Sources

5.7.1.1.2.1 Limestone

This is also known as calcium carbonate (CaCO_3) and is available in fine powder or coarse grits. This should be grayish white to off-white in color and should have no characteristic odor. This should be free from foreign materials. The specifications should include:

Calcium Min 36.0%

pH Max 9.0%

Magnesium Max 2.5%

5.7.1.1.2.2 Oyster Shell

This is obtained by drying and grinding oyster shells that should be off-white to grayish black in color and should have fishy odor. The specifications should include:

Moisture Max 5.0%

Calcium Min 30.0%

Salmonella(at 25 grams)..... Negative

5.7.1.1.3 Sodium and Chlorine Sources

5.7.1.1.3.1 Salt (NaCl)

These are granular crystals or fine powder commonly known as “table salt”. This should be white to off-white in color and should have no characteristic odor. This should be free from lumps and/or foreign materials. The specifications should include:

Animal Feed Ingredients

Moisture	Max 5.0%
Sodium	Min 37.0%
Chlorine	Min 58.0%

5.7.1.1.3.2 Iodized Salt

These are granular crystals or fine powder with iodine that should be white in color and should have no characteristic odor. This should be free from lumps and/or foreign materials. The specifications should include:

Moisture	Max 3.0%
Sodium	Min 37.0%
Chlorine	Min 58.0%
Iodine	Min 0.007%

5.7.1.1.3.3 Sodium bicarbonate

These are white crystal or granules prepared from sodium carbonate, water and carbon dioxide. This should be free from foreign materials and specifications should include:

Moisture ^m	Max 2.0%
Sodium.....	Min 26.0%

^mOven drying at 105°C for all moisture value of feed ingredients

5.7.2 Amino Acids Supplements**5.7.2.1 DI-Methionine**

It is a synthetic form of methionine that should have a typical odor, somewhat like organic sulphur compounds. The forms, colors and specifications should be the following:

Animal Feed Ingredients

DL methionine - white to slightly yellowish/crystal powder

Purity as DL-Methionine..... Min 98.0%

5.7.2.2 Methionine hydroxyl analogue (MHA)

It is a hydroxyl acid with four carbons and methyl-thio radical with pKa of 3.6. It can be either liquid or powder.

Purity as MHA liquid/powder Min 85.0%.

5.7.2.3 L-lysine HCl

It is a synthetic form of lysine that should be odorless and should include the following forms, color and specifications:

L-lysine hydrochloride- dirty white or cream

Purity as L- lysine hydrochloride Min 98.0%

5.7.2.4 Lysine sulfate

It is a light brown synthetic form of lysine and composed of pure lysine and other amino acid.

Purity as L-lysine sulfate Min 87.0%

5.7.2.5 L-threonine

This is synthetic amino acid produced by fermentation that should be off-white in color and odorless. The specification should include:

Purity as L- threonine..... Min 98.0%

5.7.2.6 L-tryptophan

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L-tryptophan is also a synthetic amino acid produced by fermentation that should be off-white in color and odorless. The specification should include:

Purity as L- tryptophan..... Min 99.0%

5.7.2.7 L-Valine

L-valine is also a synthetic amino acid produced by fermentation that should be off-white in color and odorless. The specification should include:

Purity as L-valine..... Min 95.0%

5.8 Feed Additives**5.8.1 Acidifying Agents (Acidifiers)**

Chemical products added to the feed to decrease the pH in the stomach, improving digestion and modulating the microflora in the gastro intestinal (GI) tract.

5.8.2 Anti-Caking Agents

Chemical products used to prevent formation of lumps.

5.8.3 Antimolds (Mold Inhibitors)

Chemical preservatives added to the feeds and raw materials to prevent mold development.

5.8.4 Antioxidants

Chemical products used to prevent rancidity in feeds and raw materials; protect the polyunsaturated fatty acids and the fat-soluble vitamins from destruction by peroxidation.

5.8.5 Dextrose Anhydrous

The anhydrous form of D-Glucose which is a natural monosaccharide and carbohydrate. Dextrose serves to replace lost nutrients and electrolytes. It is also use as sweetener.

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5.8.6 Enzymes

Chemical products which are added to the feed to improve nutrient digestibility.

5.8.7 Flavorings/Sweeteners

Agents added to improve palatability of the feed.

5.8.8 Hormones

Substances used to alter metabolism in the body.

5.8.9 Immuno Enhancers

Natural compounds that activate or prime the innate immune system (beta glucans, etc.).

5.8.10 Nutritional Metabolites

Molecules that are intermediate products of metabolism which are involved in normal growth, development and reproduction

5.8.11 Pellet Binders

Used to improve pellet durability.

5.8.12 Pigmenters

Used to enhance yolk color and skin pigmentation in poultry.

5.8.13 Prebiotics

Non-digestible substances used to improve the gut environment for beneficial bacteria.

5.8.14 Probiotics

Live microbial feed additives that beneficially affect the host animal by improving its intestinal microbial balance.

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5.8.15 Surfactants

Chemical agents that facilitate uniform dispersion of molecules in viscous liquid raw materials.

5.8.16 Mycotoxin Binders

Chemical compounds which can bind or adsorb mycotoxins in feeds.

6 Hazards in Feeds (guidelines)**6.1 Biological Hazards**

Bacteria, parasites, and prions.

6.2 Chemical Hazards**6.3 Heavy Metals**

Commercial feed ingredients should comply with those relevant maximum residue levels for heavy metals established by the *Codex Alimentarius* Commission and/or competent authority for this commodity.

6.4 Radionuclides**6.5 Toxins (Mycotoxins, Plant toxins, Marine Toxins)****Mycotoxins**

Mycotoxins, such as but not limited to aflatoxin, T2, zearalenone, Deoxynevalinol(DON) or vomitoxin and ochratoxin should comply with the tolerable levels set by international standardizing body or competent authority.

6.6 Pesticide Residues

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Commercial feed ingredients should comply with those relevant maximum residue limits established by the Codex Committee on Pesticide Residues and/or competent authority for this commodity.

6.7 Veterinary Drugs**7 Hygiene**

It is recommended that the product covered by the provisions of this standard be prepared and handled in accordance with appropriate sections of Recommended Code of Practice – Good Animal Feeding (CAC/RCP 54-2004).

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ANNEX 1

The following data are provided as additional information:

Table 1. Sources of Trace Minerals

Trace Minerals	Sources	Purity	Content of pure element (%)	Color	
1. Cobalt (Co)	Cobalt carbonate (CoCO_3)		49.6	Red	
	Cobalt sulfate, hydrated ($\text{CoSO}_4 \cdot \text{H}_2\text{O}$)	98-99	34.1	Strong pink	
	Cobalt sulfate, hydrated ($\text{CoSO}_4 \cdot 7\text{H}_2\text{O}$)	98-99	21.0	Orange	
2. Copper (Cu)	Copper carbonate (CuCO_3)		51.4	Green to blue	
	Copper chloride ($\text{CuCl}_2 \cdot 2\text{H}_2\text{O}$)		37.3	Blue	
	Copper hydroxide ($\text{Cu} [\text{OH}]_2$)		65.1	Light blue	
	<i>purity-not available in the Philippines</i>	Cupric oxide (CuO)	78-79	79.9	Black
		Copper Sulfate, hydrated ($\text{CuSO}_4 \cdot 5\text{H}_2\text{O}$)	98-100	25.4	Dark blue
		Copper Sulfate, hydrated ($\text{CuSO}_4 \cdot 7\text{H}_2\text{O}$)	98-100	22.2	Sky blue

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	Tribasic copper chloride (TBCC)	98	58	Green powder
3. Iodine (I)	Calcium Iodate ($\text{Ca}[\text{IO}_3]_2$)	99	65.1	White crystalline powder
	Potassium iodide (KI)	99-100	76.4	White crystals
	Cuprous iodide (CuI)	-	66.6	-?
	Pentacalciumorthoperiodate ($\text{Ca}_5[\text{IO}_6]_2$)	-	39.3	-
4. Iron (Fe)	Ferrous carbonate (FeCO_3)	-	48.2	Greenish gray
	Ferrous Oxide (FeO)	-	77.7	Jet-black
	Ferrous sulfate (FeSO_4)	98	36.7	White to yellow
	Ferrous sulfate, hydrate ($\text{FeSO}_4 \cdot \text{H}_2\text{O}$)	95-98	32.9	White to yellow
	Ferrous sulfate, hydrate ($\text{FeSO}_4 \cdot 7\text{H}_2\text{O}$)	92-97	20.1	Light green
5. Manganese (Mn)	Manganese carbonate (MnCO_3)	-	47.8	Pink
	Manganese chloride ($\text{MnCl}_2 \cdot \text{H}_2\text{O}$)	-	38.2	Reddish
	Manganous oxide (MnO)	81	77.4	Brownish –black
	Manganese sulfate, hydrated ($\text{MnSO}_4 \cdot 5\text{H}_2\text{O}$)	95-98	22.8	Light pink
	Manganous sulfate,	99	32.5	Light pink

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	hydrated ($\text{MnSO}_4 \cdot \text{H}_2\text{O}$)			
6. Selenium (Se)	Sodium selenite (Na_2SeO_3)	99-100	45.6	White
	Sodium selenite (Na_2SeO_4)	-	41.8	White
7. Zinc (Zn)	Zinc carbonate (ZnCO_3)	-	52.1	-
	Zinc chloride (ZnCl_2)	-	48.0	White
	Zinc oxide (ZnO)	88-99	80.3	Chalky white
	Zinc sulfate, hydrated ($\text{ZnSO}_4 \cdot 7\text{H}_2\text{O}$)	90-95	22.7	White
	Zinc sulfate, hydrated ($\text{ZnSO}_4 \cdot \text{H}_2\text{O}$)	95-98	36.4	White

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ANNEX 2

Table 2. Description and Activity of Commercial Vitamins

Vitamin	Source	Description*	Activity
Vitamin A	Vitamin A 1000	Orange brown to gray free-flowing coated beadlets	1,000,000 I.U./gram
	Vitamin A 500	Pale yellow to brownish free-flowing spray-dried powder; dispersible in water	500,000 I.U./gram
Vitamin D ₃	Vitamin D3 500	Cream to brownish, fine spray-dried powder	500,000 I.U./gram
Vitamin AD ₃	Vitamin AD3 1000/200	Orange brown to gray free-flowing coated beadlets; contains both vitamin A and D ₃	Vitamin A = 1,000,000 I.U./gram Vitamin D ₃ = 200,000 I.U./gram
Vitamin K ₃	Menadionesodium bisulfite	White to brownish, slightly hygroscopic powder; soluble in water	51.5 % menadione (as is)
	Menadionenicotina midebisulfite	White to brownish powder; sparingly soluble in water	43% menadione and 31% nicotinamide

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Vitamin B ₁	Thiamine mononitrate	White to yellowish fine granular powder; sparingly soluble in water	92% thiamine
	Thiamine hydrochloride	White fine powder; soluble in water	89% thiamine
Vitamin B ₆	Pyridoxine hydrochloride	White to yellowish fine, free-flowing powder	82% pyridoxine
Vitamin B ₁₂	Vitamin B ₁₂ 1%	Fine, reddish-brown powder	9 to 11 mg B ₁₂ per gram
Niacin	Niacin	Crystalline, free-flowing white to slightly yellowish powder	99.5%
Pantothenic acid	Calcium D-pantothenate	White to off-white, free flowing crystalline or spray-dried powder	90%
Biotin	Biotin 2%	White to cream white, very fine, free flowing powder	2%
	Biotin 10%	Off-white to slightly yellowish, free-flowing spray-dried powder	10%
Folic acid	Folic acid 95%	Yellow to yellow-orange powder	95%

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	Folic acid 80% spray-dried	Yellowish to brownish free- flowing spray-dried power	80%
Vitamin C	Coated vitamin C	White to slightly yellowish powder coated with ethylcellulose	97.5%
Choline chloride	Phosphorylated vitamin C	Beige, spray-dried powder	35%

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Animal Feed Ingredients

**Department of Agriculture
Bureau of Agriculture and Fisheries Standards
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