

3. Feed terms and ingredient classification

Prior to listing individual feed ingredient sources and their nutrient content it is important here to first provide a glossary of nutrient and feed milling terms which are commonly used to describe individual feed ingredients. For a complete listing of official feed terms, readers should consult with the Official Publication of the Association of American Feed Control Officials (AAFCO, 2008a) and the publications of Millamena, Coloso and Pascual (2002).

3.1 GLOSSARY OF MAJOR FEED AND FEED MILLING TERMS

Additive: An ingredient or combination of ingredients added to the basic feed mix or parts thereof to fulfill a specific need. Usually used in micro quantities and requires careful handling and mixing (AAFCO, 2008a).

Ad libitum feeding: Providing unlimited amount of feed until satiation (Millamena, Coloso and Pascual, 2002).

Amino acid: A carboxylic acid that includes an amino group as part of its structure; any one class of organic compounds which contain both the amino (NH₂) group and the carboxyl (COOH) group (Millamena, Coloso and Pascual, 2002).

Amino acid antagonism: Occurs when some amino acids are fed in excess of required levels causing an increase in the requirement for another amino acid of similar structure, e.g. arginine-lysine antagonism (Millamena, Coloso and Pascual, 2002).

Anaerobic: A condition or chemical reaction where gaseous oxygen is not present or not required, e.g. decomposition of organic wastes by microorganisms, releasing toxic hydrogen sulfide and methane gas (Millamena, Coloso and Pascual, 2002).

Animal waste: Means a material composed of excreta, with or without bedding materials, and collected from poultry, ruminants or other animals except humans (AAFCO, 2008a).

Antibiotics: A class of drug. They are usually synthesized by a living microorganism and in proper concentration inhibit the growth of other microorganisms (AAFCO, 2008a).

Antinutritional factors: Substances in the feedstuff which can reduce nutritional value (Millamena, Coloso and Pascual, 2002).

Antioxidant: A strong reducing agent, which is easily oxidized and thus prevents the oxidation of other substances (Millamena, Coloso and Pascual, 2002).

Aquafeeds: Feeds that are intended for aquaculture species (Millamena, Coloso and Pascual, 2002).

Arachidonic acid: A 20-carbon unsaturated fatty acid having four double bonds (Millamena, Coloso and Pascual, 2002).

Artificially dried: (Process) Moisture having been removed by other than natural means (AAFCO, 2008a).

Aspirated, Aspirating: Having removed chaff, dust or other light materials by use of air (AAFCO, 2008a).

Attractant: Substances added to feeds for fast consumption especially by crustacean species (Millamena, Coloso and Pascual, 2002).

Bagasse: (Part) Pulp from sugar cane (AAFCO, 2008a).

Balanced: A term that may be applied to a diet, ration or feed having all known required nutrients in proper amount and proportion based on recommendations of recognized authorities in the field of animal nutrition, such as the National Research Council, for a given set of physiological animal requirements. The species for which it is intended and the functions such as maintenance or maintenance plus production (growth, foetus, fat, milk, eggs, wool, feathers or work) shall be specified (AAFCO, 2008a).

Barn-cured: (Process) Forage material dried with forced ventilation in an enclosure (AAFCO, 2008a).

Beans: Seed of leguminous plants especially of the genera *Phaseolus*, *Dali Chos* and *Vigna* (AAFCO, 2008a).

Benthos: Organisms that live on or in the sediment of aquatic environments (Millamena, Coloso and Pascual, 2002).

Binder: Substances added to feeds to make it stable in the water, usually a carbohydrate (Millamena, Coloso and Pascual, 2002).

Blending: (Process) To mingle or combine two or more ingredients of feed. It does not imply a uniformity of dispersion (AAFCO, 2008a).

Blood: (Part) Vascular fluid of animals (AAFCO, 2008a).

Blood albumin: (Part) One of the blood proteins (AAFCO, 2008a).

Bone: (Part) Skeletal parts of vertebrates (AAFCO, 2008a).

Boneless: (Process) The flesh resulting from removal of bone from accompanying flesh by means of knife separation (AAFCO, 2008a).

Bran: (Part) Pericarp of grain (AAFCO, 2008a).

Buttermilk: (Part) A residue from churning cream (AAFCO, 2008a).

By-product: (Part) Secondary products produced in addition to the principal product (AAFCO, 2008a).

Cake: (Physical form) The mass resulting from the pressing of seeds, meat or fish in order to remove oils, fats or other liquids (AAFCO, 2008a).

Calorie: A unit of heat or energy; the amount of heat required to raise 1 g of water to 1°C. Nutritionally, the kcal is sometimes used; 1 kcal = 1 000 cal, 1 cal = 4.186 joules, 1 joule = 0.239 cal (Millamena, Coloso and Pascual, 2002).

Canned: (Process) a term applied to a feed which has been processed, packaged, sealed and sterilized for preservation in cans or similar containers (AAFCO, 2008a).

Cannery residue: (Part) Residue suitable for feeding obtained in preparing a product for canning (AAFCO, 2008a).

Carbohydrate: A large group of organic compounds common in plants which include simple sugars, starches, celluloses, gums and related substances (Millamena, Coloso and Pascual, 2002).

Carcass meat trimmings: (Part) Clean flesh obtained from slaughtered animals. It is limited to striated, skeletal and cardiac muscles, but may include the accompanying and overlaying fat and the portion of skin, sinew, nerve and blood vessels which normally accompany the flesh (AAFCO, 2008a).

Carcass residue, mammals: (Part) Residues from animal tissues including bones and exclusive of hair, hoofs, horns and contents of the digestive tract (AAFCO, 2008a).

Carriers: An edible material to which ingredients are added to facilitate uniform incorporation of the latter into feeds. The active particles are absorbed, impregnated or coated into or onto the edible material in such a way as to physically carry the active ingredient (AAFCO, 2008a).

Casein: The colloidal protein in milk (Millamena, Coloso and Pascual, 2002).

Cellulose: A polymer of glucose, an important structural material in plants; major structural component of plant cell wall (Millamena, Coloso and Pascual, 2002).

Chaff: (Part) Glumes, husks or other seed covering together with other plant parts separated from seed during threshing or processing (AAFCO, 2008a).

Charcoal: Dark-coloured porous forms of carbon made from the organic parts of vegetable or animal substances, by their incomplete combustion (AAFCO, 2008a).

Chipped, chipping: (Process) Cut or broken into fragments; also meaning prepared into small thin slices (AAFCO, 2008a).

Chitin: Major structural component of the rigid exoskeleton of invertebrates (Millamena, Coloso and Pascual, 2002).

Cholesterol: A physiologically important sterol which is widespread in the biomembrane (Millamena, Coloso and Pascual, 2002).

Chopped, chopping: (Process) Reduced in particle size by cutting with knives or other edged instruments (AAFCO, 2008a).

Cleaned, cleaning: (Process) Removal of material by such methods as scalping, aspirating, magnetic separation, or by any other method (AAFCO, 2008a).

Cleanings: (Part) Chaff, weed seeds, dust and other foreign matter removed from cereal grain (AAFCO, 2008a).

Cobs with grain: (Part) The ears of maize without the husks, but consisting of the entire cobs and adhering grain (AAFCO, 2008a).

Cobs with husks: (Part) Kernel-free fibrous inner portion of the ear of maize with enveloping leaves (AAFCO, 2008a).

Coenzyme: A nonprotein substance that takes part in an enzymatic reaction and is regenerated at the end of the reaction; a partner required by some enzymes to produce enzymatic activity (Millamena, Coloso and Pascual, 2002).

Cofactor: An inorganic ion or coenzyme required for enzymatic activity (Millamena, Coloso and Pascual, 2002).

Complete feed: A nutritionally adequate feed for animals other than man; by specific formula is compounded to be fed as the sole ration and is capable of maintaining life and/or promoting production without any additional substance being consumed except water (AAFCO, 2008a).

Complete diet: Feed that contains all the essential nutrients (protein, lipid, carbohydrate, vitamins, minerals) required by the animal for maintenance and growth (Millamena, Coloso and Pascual, 2002).

Compound feed: A feed composed of several ingredients (Millamena, Coloso and Pascual, 2002).

Concentrate: A feed used with another to improve the nutritive balance of the total and intended to be further diluted and mixed to produce a supplement or a complete feed (AAFCO, 2008a).

Condensed, condensing: (Process) Reduced to denser form by removal of moisture (AAFCO, 2008a).

Conditioned, conditioning: (Process) Having achieved predetermined moisture characteristics and/or temperature of ingredients or a mixture of ingredients prior to further processing (AAFCO, 2008a).

Cooked, cooking: (Process) Heated in the presence of moisture to alter chemical and/or physical characteristics or to sterilize (AAFCO, 2008a).

Cracked, cracking: (Process) Particle size reduced by a combined breaking and crushing action (AAFCO, 2008a).

Cracklings: (Part) Residue after removal of fat from adipose tissue or skin of animals by dry heat (AAFCO, 2008).

Crimped, crimping: (Process) Rolled by use of corrugated rollers. It may curtail tempering or conditioning and cooling (AAFCO, 2008a).

Crumbled, crumbling: (Process) Pellets reduced to granular form (AAFCO, 2008a).

Crumbles: (Physical form) Pelleted feed reduced to granular form (AAFCO, 2008a).

Crushed, crushing: (Process) See rolled, rolling (AAFCO, 2008a).

Cull: Material rejected as inferior to the process of grading or separating (AAFCO, 2008a).

Culture: Nutrient medium inoculated with specific microorganisms which may be in a live or dormant condition (AAFCO, 2008a).

Cultured, culturing: (Process) Biological material multiplied or produced in a nutrient media (AAFCO, 2008a).

Cure, curing, cured: (Process) To prepare for keeping for use, or to use, or to preserve. The process may be by drying, use of chemical preservatives, smoking, salting, or by use of other processes and/or materials for preserving (AAFCO, 2008a).

Customer-formula feed: Consists of a mixture of commercial feeds and/or feed ingredients each batch of which is manufactured according to the specific instructions of the final purchaser (AAFCO, 2008a).

Cut, cutting: (Process) See chopped, chopping (AAFCO, 2008a).

D-activated, D-activating: Plant or animal sterol fractions which have been Vitamin D activated by ultraviolet light or by other means (AAFCO, 2008a).

Deboned: (Process) The flesh resulting from removal of bones from accompanying flesh by mechanical deboning (AAFCO, 2008a).

Defluorinated, defluorinating: (Process) Having had fluorine removed (AAFCO, 2008a).

Degermed: (Process) Having had the embryo of seeds wholly or partially separated from the starch endosperm (AAFCO, 2008a).

Dehulled, dehulling: (Process) Having removed the outer covering from grains or other seeds (AAFCO, 2008a).

Dehydrating, dehydrated: (Process) Having been freed of moisture by thermal means (AAFCO, 2008a).

Diatom: A single-celled plant (phytoplankton) covered with two overlapping porous shells of silica (Millamena, Coloso and Pascual, 2002).

Diet: Feed ingredients or mixture of ingredients including water which are consumed by animals (AAFCO, 2008a).

Digested, digesting: (Process) Subjected to prolonged heat and moisture, or to chemicals or enzymes with a resultant change of decomposition of the physical or chemical nature (AAFCO, 2008a).

Diluent: (Physical form) An edible substance used to mix with and reduce the concentration of nutrients and or additives to make them more acceptable to animals, safer to use, and more capable of being mixed uniformly in a feed (it may also be a carrier) (AAFCO, 2008).

Distillation soluble: (Part) Stillage filtrate (AAFCO, 2008a).

Docosahexaenoic acid (DHA): A 22-carbon unsaturated fatty acid having six double bonds, an essential fatty acid in fish (Millamena, Coloso and Pascual, 2002).

Dressed, dressing: (Process) Made uniform in texture by breaking or screening of lumps from feed and/or the application of liquid(s) (AAFCO, 2008a).

Dried, drying: (Process) Materials from which water or other liquid has been removed (AAFCO, 2008a).

Drug: (as defined by FDA as applied to feed) A substance (a) intended for use in the diagnosis, cure, mitigation, treatment or prevention of disease in man or other animals or (b) a substance other than food intended to affect the structure or any function of the body of man or other animals (AAFCO, 2008a).

Dry-milled: (Process) Tempered with a small amount of water or steam to facilitate the separation of the various component parts of the kernel in the absence of any significant amount of free water (AAFCO, 2008a).

Dry-rendered, dry-rendering: (Process) Residues of animal tissue cooked in open steam-jacketed vessels until the water has evaporated. Fat is removed by draining and pressing the solid residue (AAFCO, 2008a).

Dust: (Part) Fine, dry pulverized particles of matter usually resulting from the cleaning or grinding of grain (AAFCO, 2008a).

Ears: (Part) Fruiting heads of *Zea mays*, including only the cob and grain (AAFCO, 2008a).

Egg albumin: (Part) Whites of eggs of poultry (AAFCO, 2008a).

Eicosapentaenoic acid (EPA): A 20-carbon unsaturated fatty acid having five double bonds, an essential fatty acid in fish (Millamena, Coloso and Pascual, 2002).

Environmental nutrition: The role of nutritional factors in altering animal impacts on the environment (AAFCO, 2008a).

Enzymatic activity: the catalytic activity required to convert a given amount of assay substrate to a given amount of product per unit time under the standard conditions set forth in the assay procedure (AAFCO, 2008a).

Enzyme: A protein made up of amino acids or their derivatives, which catalyzes a defined chemical reaction. Required cofactors should be considered an integral part of the enzyme (AAFCO, 2008a).

Enzyme product: A processed, standardized enzyme-containing material which has been produced with the intention of being sold for use in animal feed and feed ingredients (AAFCO, 2008a).

Emulsifier: A material capable of causing fat or oils to remain in liquid suspension (AAFCO, 2008a).

Endosperm: (Part) Starchy portion of seed (AAFCO, 2008a).

Ensiled: (Process) Aerial parts of plants which have been preserved by ensiling. Normally the original material is finely cut and placed in an airtight chamber such as a silo, where it is pressed to exclude air and where it undergoes an acid fermentation that retards spoilage (AAFCO, 2008a).

Etiolated: (Process) A material grown in the absence of sunlight, blanched, bleached, colourless or pale (AAFCO, 2008).

Evaporated, evaporating: (Process) Reduced to a denser form; concentrated as by evaporation or distillation (AAFCO, 2008a).

Eviscerated: (Process) Having had all the organs in the great cavity of the body removed (AAFCO, 2008a).

Expanded, expanding: (Process) Subjected to moisture, pressure and temperature to gelatinize the starch portion. During extrusion, volume is increased because of abrupt reduction in pressure (AAFCO, 2008a).

Extracted, mechanical: (Process) Having removed fat or oil from materials by heat and mechanical pressure. Similar terms: expeller extracted, hydraulic extracted, "oil process" (AAFCO, 2008a).

Extracted, solvent: (Process) Having removed fat or oil from materials by organic solvents. Similar term: "new process" (AAFCO, 2008a).

Extruded: (Process) A process by which feed has been pressed, pushed or protruded through orifices under pressure (AAFCO, 2008a).

Farm-made aquafeeds: Feeds in pellet or other forms, consisting of one or more artificial and/or natural feedstuff, produced for the exclusive use of a particular farming activity, not for commercial sale or profit (New, Tacon and Csavas, 1995).

Fat: (Part) A substance composed chiefly of triglycerides of fatty acids, and solid or plastic at room temperature (AAFCO, 2008a).

Fatty acids: (Part) Aliphatic monobasic acids containing only the elements carbon, hydrogen and oxygen (AAFCO, 2008a).

Feathers: (Part) The light, horny epidermal outgrowths that form the external coverings of birds (AAFCO, 2008a).

Feed(s): Edible material(s) which are consumed by animals and contribute energy and/or nutrients to the animals' diet (AAFCO, 2008a). (Usually refers to animals rather than to man.)

Feed grade: Suitable for animal consumption (AAFCO, 2008a).

Feed mixture: See formula feed.

Feedstuff: One or a mixture of substances which form the nutrients – protein, carbohydrate, fat, vitamins, minerals and water – that are eaten by an animal as part of its daily ration (Millamena, Coloso and Pascual, 2002).

Fermentation aid: A substance added to assist in providing proper conditions which result in action by yeasts, molds or bacteria in a controlled aerobic or anaerobic process used for the manufacture of certain products (AAFCO, 2008a).

Fermented, fermenting: (Process) Acted upon by yeasts, molds or bacteria in a controlled aerobic or anaerobic process in the manufacture of such products as alcohols, acids, vitamins of the B-complex group, or antibiotics (AAFCO, 2008a).

Fibre: (Part) Any of a large class of plant carbohydrates that resist digestion hydrolysis (AAFCO, 2008a).

Filler: A substance added in the feed to complete the feed formula (Millamena, Coloso and Pascual, 2002).

Fines: (Physical form) Any materials which will pass through a screen whose openings are immediately smaller than the specified minimum crumble size or pellet diameter (AAFCO, 2008a).

Flaked, flaking: (Process) See rolled.

Flakes: (Physical form) An ingredient rolled or cut into flat pieces with or without prior steam conditioning (AAFCO, 2008a).

Floating feed: Produced by an extrusion process through which feed materials are moistened, pre-cooked, expanded (higher moisture, temperature and pressure than ordinary pelleting) and dried, resulting in low density feed particles (Millamena, Coloso and Pascual, 2002).

Flour: (Part) Soft, finely ground and bolted meal obtained from the milling of cereal grains, other seeds, or products. It consists essentially of the starch and gluten of the endosperm (AAFCO, 2008a).

Fodder: (Part) The green or cured plant, containing all the ears or seed heads, if any, grown primarily for forage (it has been applied more specifically to corn and sorghum) (AAFCO, 2008a).

Food(s): When used in reference to animals, it is synonymous with feed(s). See feed(s) (AAFCO, 2008a).

Formula feed: Two or more ingredients proportioned, mixed and processed according to specifications (AAFCO, 2008a).

Free choice: A feeding system by which animals are given unlimited access to the separate components or groups of components constituting the diet (AAFCO, 2008a).

Fresh: (Process) Ingredient(s) having not been subject to freezing, to treatment by cooking, drying, rendering, hydrolysis, or similar process, to the addition of salt, curing agents, natural or synthetic chemical preservatives or other processing aids, or to preservation by means other than refrigeration (AAFCO, 2008a).

Fused, fusing: (Process) Melted by heat (AAFCO, 2008a).

Gelatinized, gelatinizing: (Process) Having had the starch granules completely ruptured by a combination of moisture, heat and pressure, and in some instances, by mechanical shear (AAFCO, 2008a).

Germ: (Part) The embryo found in seeds and frequently separated from the bran and starch endosperm during the milling process (AAFCO, 2008a).

Glucose: A monosaccharide; a hexose (six-carbon) sugar, of empirical formula C₆H₁₂O₆ basic molecule for the synthesis of starch and cellulose (Millamena, Coloso and Pascual, 2002).

Gluten: (Part) The tough, viscid nitrogenous substance remaining when the flour of wheat or other grain is washed to remove the starch (AAFCO, 2008a).

Glycerol: A trihydric alcohol to which three fatty acid molecules are esterified in the formation of triacylglycerols (fats and oils) (Millamena, Coloso and Pascual, 2002).

Glycogen: A branched chain polymer of glucose, linked by alpha 1-6 links; the storage form of carbohydrate in animals, as starch is in plants (Millamena, Coloso and Pascual, 2002).

Gossypol: (Part) A phenolic pigment in cottonseed that is toxic to some animals (AAFCO, 2008a).

Grain: (Part) Seed from cereal plants (AAFCO, 2008a).

GRAS: Abbreviation for the phrase “Generally Recognized as Safe”. A substance which is generally recognized as safe by experts qualified to evaluate the safety of the substance for its intended use (AAFCO, 2008a).

Grease: Animal fats with a titre below 40 °C (AAFCO, 2008a).

Grit: Coarse ground, insoluble, non-nutritive material (e.g. granite rock) for the *in vivo* mechanical grinding of feed by avian species (AAFCO, 2008a).

Grits: (Part) Coarsely ground grain from which the bran and germ have been removed, usually screened to uniform particle size (AAFCO, 2008a).

Groats: (Part) Grain from which the hulls have been removed (AAFCO, 2008a).

Ground, grinding: (Process) Reduced in particle size by impact, shearing or attrition (AAFCO, 2008a).

Hay: (Part) The aerial portion of grass or herbage especially cut and cured for animal feeding (AAFCO, 2008a).

Heads: (Part) The seed or grain-containing portions of a plant (AAFCO, 2008a).

Heat-processed, heat-processing: (Process) Subjected to a method of preparation involving the use of elevated temperatures with or without pressure (AAFCO, 2008a).

Heat rendered, heat rendering: (Process) Melted, extracted or clarified through use of heat. Usually, water and fat are removed (AAFCO, 2008a).

Hemicellulose: Composed of a mixture of hexose and pentose units; any of various polysaccharides that accompany cellulose and lignin in the skeletal substances of wood and green plants. Unlike cellulose, it can be hydrolyzed in relatively mild acids (Millamena, Coloso and Pascual, 2002).

Hexose: A monosaccharide with six carbon atoms, and hence the empirical formula C₆H₁₂O₆. The nutritionally important hexoses are glucose, galactose and fructose (Millamena, Coloso and Pascual, 2002).

Highly unsaturated fatty acids (HUFA): Fatty acids that contain four or more double bonds (Millamena, Coloso and Pascual, 2002).

Homogenized, homogenizing: (Process) Particles broken down into evenly distributed globules small enough to remain emulsified for long periods of time (AAFCO, 2008a).

Hulls: (Part) Outer covering of grain or other seed (AAFCO, 2008a).

Husks: (Part) Leaves enveloping an ear of maize; or the outer coverings of kernels or seeds, especially when dry and membranous (AAFCO, 2008a).

Hydrolyzed, hydrolyzing: (Process) Complex molecules having been split to simpler units by chemical reaction with water, usually by catalysis (AAFCO, 2008a).

Ingredient, feed ingredient: Means a component part or constituent of any combination or mixture making up a commercial feed (AAFCO, 2008a).

Irradiated, irradiating: (Process) Treated, prepared or altered by exposure to a specific radiation (AAFCO, 2008a).

Juice: (Part) The aqueous substance obtainable from biological tissue by pressing or filtering with or without addition of water (AAFCO, 2008a).

Keratin: A sulfur-containing protein which is the primary component of epidermis, hair, wool, hoof, horn and the organic matrix of the teeth (Millamena, Coloso and Pascual, 2002).

Kernel: (Part) A whole grain. For other species, dehulled seed (AAFCO, 2008a).

Kibbled, kibbling: (Process) Cracked or crushed baked dough, or extruded feed that has been cooked prior to or during the extrusion process (AAFCO, 2008a).

Lablab: Natural food in ponds, composed of complex of blue-green and green algae, diatoms, rotifers, crustaceans, insects, roundworms, detritus and plankton (Millamena, Coloso and Pascual, 2002).

Lactose: The sugar of milk; a disaccharide composed of glucose and galactose (Millamena, Coloso and Pascual, 2002).

Laboratory method: A technique or procedure of conducting scientific experiment, test, investigation or observation according to a definite established logical or systematic plan (AAFCO, 2008a).

Lard: (Part) Rendered fat of swine (AAFCO, 2008a).

Leached: (Process) The condition of a product following subjection of the material to the action of percolating water or other liquid (AAFCO, 2008a).

Leaves: (Part) Lateral outgrowths of stems that constitute part of the foliage of a plant, typically a flattened green blade which primarily functions in photosynthesis (AAFCO, 2008a).

Lecithin: (Part) A specific phospholipid. The principal constituent of crude phosphatides derived from oil-bearing seeds (AAFCO, 2008a).

Lignin: A polymer of coniferyl alcohol; a structural material found in woody plants (Millamena, Coloso and Pascual, 2002).

Linolenic acid: A 18-carbon unsaturated fatty acid having three double bonds (Millamena, Coloso and Pascual, 2002).

Lipids: A broad term for fats and fat-like substances including phospholipids, waxes, steroids and sphingomyelins (Millamena, Coloso and Pascual, 2002).

Liver: (Part) The hepatic gland (AAFCO, 2008a).

Macronutrients: Nutrients needed in large amounts such as proteins, carbohydrates or lipids (Millamena, Coloso and Pascual, 2002).

Malt: (Part) Sprouted and steamed whole grain from which the radicle has been removed (AAFCO, 2008a).

Malted, malting: (Process) Converted into malt or treated with malt or malt extract (AAFCO, 2008a).

Maltose: A disaccharide composed of two molecules of glucose (Millamena, Coloso and Pascual, 2002).

Mash: (Physical form) A mixture of ingredients in meal form. Similar term: mash feed (AAFCO, 2008a).

Meal: (Physical form) An ingredient which has been ground or otherwise reduced in particle size (AAFCO, 2008a).

Medicated feed: Any feed which contains drug ingredients intended or presented for the cure, mitigation, treatment or prevention of diseases of animals other than man or which contains drug ingredients intended to affect the structure or any function of the body of animals other than man. Antibiotics included in a feed for growth promotion and/or efficiency levels are drug additives and feeds containing such antibiotics are included in the foregoing definition of “Medicated feed.” (AAFCO, 2008a).

Metal (mineral) salt: An ionic substance containing a metal cation and either an inorganic or an organic anion. The water soluble portion of a metal (mineral) salt dissociates in water to give the hydrated metal cation and the free anion (or its hydrolysis product) in solution (AAFCO, 2008a).

Metal (mineral) complex: A substance in which a metal cation (electron pair acceptor) accepts an electron pair from one or more anionic or neutral bonding partners (ligands, electron pair donors) to form chemical bonds. The water soluble portion of the complex remains as the intact complex in aqueous solution (AAFCO, 2008a).

Metal (mineral) chelate: A metal complex (see preceding term) in which at least one ligand (electron pair donor) forms two or more bonds to the central metal ion through different atoms of the ligand. A distinctive feature of a metal chelate is the presence of a heterocyclic ring(s) in which the metal is a member of the ring. In the water soluble portion of the chelate, the heterocyclic ring(s) remains intact (AAFCO, 2008a).

Microencapsulated feed: A larval feed made by encapsulating a solution, colloid or suspension of feed ingredient mixture within a membrane or capsule; these particles can be designed to have a slow release of the material inside the capsule, or to totally prevent leaching of the water-soluble nutrients (Millamena, Coloso and Pascual, 2002).

Micro-ingredients: Vitamins, minerals, antibiotics, drugs and other materials normally required in small amounts and measured in milligrams, micrograms or parts per million (ppm) (AAFCO, 2008a).

Middlings: (Part) A by-product of flour milling comprising several grades of granular particles containing different proportions of endosperm, bran, germ, each of which contains different levels of crude fibre (AAFCO, 2008a).

Milk: Total lacteal secretion from the mammary gland (AAFCO, 2008a).

Mill by-product: (Part) A secondary product obtained in addition to the principal product in milling practice (AAFCO, 2008a).

Mill dust: (Part) Fine feed particles of undetermined origin resulting from handling and processing feed and feed ingredients (AAFCO, 2008a).

Mill run: (Part) The state in which a material comes from the mill, ungraded and usually uninspected (AAFCO, 2008a).

Mineralize, mineralized: (Process) To supply, impregnate or add inorganic mineral compounds to a feed ingredient or mixture (AAFCO, 2008a).

Mixing: (Process) To combine by agitation two or more materials to a specific degree of dispersion (AAFCO, 2008a).

Molasses: (Part) The thick, viscous by-product resulting from refined sugar production or the concentrated, partially dehydrated juices from fruits (AAFCO, 2008a).

Mold inhibitor: Substances added to feeds that inhibit mold growth (Millamena, Coloso and Pascual, 2002).

Monosaccharide: A simple sugar, the basic units from which disaccharides and polysaccharides are composed. The nutritionally important monosaccharides are the pentoses (five-carbon sugars) and the hexoses (six-carbon sugars) (Millamena, Coloso and Pascual, 2002).

Natural: A feed or ingredient derived solely from plant, animal or mined sources, either in its unprocessed state or having been subject to physical processing, heat processing, rendering, purification, extraction, hydrolysis, enzymolysis or fermentation, but not having been produced by or subject to a chemically synthetic process and not containing any additives or processing aids that are chemically synthetic except in amounts as might occur unavoidably in good manufacturing practices (AAFCO, 2008a).

Nutrient: A feed constituent in a form and at a level that will help support the life of an animal. The chief classes of feed nutrients are proteins, fats, carbohydrates, minerals and vitamins (AAFCO, 2008a).

Nutrition: The science of nourishing an organism; the sum of the processes by which an animal or plant absorbs and utilizes food substances. It involves the ingestion, digestion, absorption and transport of food nutrients into body cells and release of waste products of metabolism (Millamena, Coloso and Pascual, 2002).

Offal: (Part) Material left as a by-product from the preparation of some specific product, less valuable portions and the by-products of milling (AAFCO, 2008a).

Oil: (Part) A substance composed chiefly of triglycerides of fatty acids and liquid at room temperature (AAFCO, 2008a).

Oligosaccharides: A general term for polymers containing about 3-10 monosaccharides (Millamena, Coloso and Pascual, 2002).

Organic: (process) A formula feed or a specific ingredient within a formula feed that has been produced and handled in compliance with the requirements of the FDA National Organic Program (AAFCO, 2008a).

Parboiling: A hydrothermal process in which the crystalline form of starch is changed into the amorphous form, due to the irreversible swelling and fusion of starch. This is accomplished by soaking, steaming, drying and milling to produce physical and chemical modifications (AAFCO, 2008a).

Pearled, pearling: (Process) Dehulled grains reduced by machine brushing into smaller smooth particles (AAFCO, 2008a).

Peel: (Part) See skin.

Pellets: (Physical form) Agglomerated feed formed by compacting and forcing through die openings by a mechanical process. Similar terms: pelleted feed, hard pellet (AAFCO, 2008a).

Pellets, soft: (Physical form) Similar term: High molasses pellets. Pellets containing sufficient liquid to require immediate dusting and cooling (AAFCO, 2008a).

Pelleted, pelleting: (Process) Having agglomerated feed by compaction and forced through die openings (AAFCO, 2008a).

Peptide bond: The link between amino acids in a protein; formed by condensation between the carboxylic acid group (-COOH) of one amino acid and the amino group (NH₂) of another to give a -CO- NH- link between the amino acids (Millamena, Coloso and Pascual, 2002).

Phospholipid: A lipid in which glycerol is esterified to two fatty acids, but the third hydroxyl group is esterified to phosphate, and through the phosphate to one of a variety of other compounds; esters of fatty acid, glycerol and phosphatidic acid (Millamena, Coloso and Pascual, 2002).

Phytoplankton: Microscopic aquatic plants suspended in the water column; major oxygen-producing organisms in a pond (Millamena, Coloso and Pascual, 2002).

Plankton: The microscopic plant and animal life in the water including bacteria (Millamena, Coloso and Pascual, 2002).

Plant gums: Complex, highly branched residues containing D-glucuronic and D-galacturonic acids along with other simple sugars such as arabinose and shambose (Millamena, Coloso and Pascual, 2002).

Polished, polishing: (Process) Having a smooth surface produced by mechanical process usually by friction (AAFCO, 2008a).

Polysaccharides: Formed by the combination of hexoses or other monosaccharides (Millamena, Coloso and Pascual, 2002).

Polyunsaturated fatty acids (PUFA): Fatty acids with two or more carbon-carbon double bonds in the molecule, separated by a methylene (-CH₂) group (Millamena, Coloso and Pascual, 2002).

Pomace: (Part) Pulp from fruit or vegetables. See pulp (AAFCO, 2008a).

Precipitated, precipitating: (Process) Separated from suspension or a solution as a result of some chemical or physical change brought about by a chemical reaction, by cold or by any other means (AAFCO, 2008a).

Premix: A uniform mixture of one or more micro-ingredients with diluent and/or carrier. Premixes are used to facilitate uniform dispersion of the micro-ingredients in a large mix (AAFCO, 2008a).

Premixing: (Process) The preliminary mixing of ingredients with diluents and/or carriers (AAFCO, 2008a).

Preservative: A substance added to protect, prevent or retard decay, discoloration or spoilage under conditions of use or storage (AAFCO, 2008a).

Pressed, pressing: (Process) Compacted or molded by pressure; also meaning having fat, oil or juices extracted under pressure (AAFCO, 2008a).

Presswater: The aqueous extract of fish or meat free from the fats and/or oils. Presswater is the result of hydraulic pressing of the fish or meat followed by separation of the oil by centrifuging or other means (AAFCO, 2008a).

Product: (Part) A substance produced from one or more other substances as a result of chemical or physical change (AAFCO, 2008a).

Protein: (Part) Any of a large class of naturally occurring complex combinations of amino acids (AAFCO, 2008a).

Processed animal waste: Animal waste that has been artificially dried, dry stacked, ensiled, oxidized, chemically treated, micro-biologically digested, chemically or physically fractionated or otherwise treated to render the material suitable for feeding (AAFCO, 2008a).

Pulp: (Part) The solid residue remaining after extraction of juices from fruits, roots or stems. Similar terms: Bagasse and Pomace (AAFCO, 2008a).

Pulverized, pulverizing: (Process) See ground, grinding (AAFCO, 2008a).

Ration: The amount of the total feed which is provided to one animal over a 24-hour period (AAFCO, 2008a).

Raw: Food in its natural or crude state not having been subjected to heat in the course of preparation as food (AAFCO, 2008a).

Refuse: (Part) Damaged, defective or superfluous edible material produced during or left over from a manufacturing or industrial process (AAFCO, 2008a).

Residue: Part remaining after the removal of a portion of its original constituents (AAFCO, 2008a).

Rolled, rolling: (Process) Having changed the shape and/or size of particles by compressing between rollers. It may entail tempering or conditioning (AAFCO, 2008a).

Roots: (Part) Subterranean parts of plants (AAFCO, 2008a).

Rumen contents: Contents of the first two compartments of the stomach of a ruminant (AAFCO, 2008a).

Rumen protected: Refers to a nutrient(s) fed in such a form that provides an increase in the flow of that nutrient(s), unchanged, to the abomasum, yet is available to the animal in the intestine (AAFCO, 2008a).

Scalped, scalping: (Process) Having removed larger material by screening (AAFCO, 2008a).

Scratch: (Physical form) Whole, cracked or coarsely cut grain. Similar terms: scratch grain, scratch feed (AAFCO, 2008a).

Screened, screening: (Process) Having separated various sized particles by passing over and/or through screens (AAFCO, 2008a).

Seed: (Part) The fertilized and ripened ovule of a plant (AAFCO, 2008a).

Self fed: A feeding system where animals have continuous free access to some or all components of a ration, either individually or as mixtures (AAFCO, 2008a).

Separating: (Process) Classification of particles by size, shape and/or density (AAFCO, 2008a).

Separating, magnetic: (Process) Removing ferrous material by magnetic attraction (AAFCO, 2008a).

Shells: (Part) The hard, fibrous or calcareous covering of a plant or animal product, i.e. nut, egg, oyster (AAFCO, 2008a).

Shoots: (Part) The immature aerial parts of plants, stems with leaves and other appendages in contrast to the roots (AAFCO, 2008a).

Shorts: (Part) Fine particles of bran, germ, flour or offal from the tail of the mill from commercial flour milling (AAFCO, 2008a).

Sifted: (Process) Materials that have been passed through wire sieves to separate particles in different sizes. The separation of finer materials than would be done by screening (AAFCO, 2008a).

Sinking feed: Prepared through extrusion under fairly low temperature and pressure such that pellets produced sink when placed in water (Millamena, Coloso and Pascual, 2002).

Sizing: (Process) See screening (AAFCO, 2008a).

Skimmed: (Process) Material from which floating solid material has been removed. It is also applied to milk from which fat has been removed by centrifuging (AAFCO, 2008a).

Skin: (Part) Outer coverings of fruits or seeds, as the rinds, husks or peels. May also apply to dermal tissue of animals (AAFCO, 2008a).

Sludge: The suspended or dissolved solid matter resulting from the processing of animal or plant tissue for human food (AAFCO, 2008a).

Solubles: Liquid containing dissolved substances obtained from processing animal or plant materials. It may contain some fine suspended solids (AAFCO, 2008a).

Solvent extracted: (Process) A product from which oil has been removed by solvents (AAFCO, 2008a).

Spent: Exhausted of active or effective properties, i.e. absorbing activity (AAFCO, 2008a).

Spray dehydrated: (Process) Material which has been dried by spraying on the surface of a heated drum. It is recovered by scraping from the drum (AAFCO, 2008a).

Spray dried: Material which has been dried by spraying or atomizing into a draft of heated dry air (AAFCO, 2008a).

Stalk(s): (Part) The main stem of a herbaceous plant often with its dependent parts such as leaves, twigs and fruit (AAFCO, 2008a).

Starch: (Part) A white, granular polymer of plant origin. The principal part of seed endosperm (AAFCO, 2008a).

Starch: A polymer of glucose units; are usually polycyclic long-chain alcohols; principal storage form of carbohydrates in plants (Millamena, Coloso and Pascual, 2002).

Steamed, steaming: (Process) Having treated ingredients with steam to alter physical and/or chemical properties. Similar terms: steam cooked, steam rendered, tanked (AAFCO, 2008a).

Steep-extracted, steep-extracting: (Process) Soaked in water or other liquid (as in the wet milling of corn) to remove soluble materials (AAFCO, 2008a).

Steepwater: Water containing soluble materials extracted by steep-extraction, i.e. by soaking in water or other liquid (as in the wet milling of corn) (AAFCO, 2008a).

Stem: (Part) The coarse, aerial parts of plants which serve as supporting structures for leaves, buds, fruit, etc. (AAFCO, 2008a).

Sterols: (Part) Solid cyclic alcohols which are the major constituents of the unsaponifiable portion of animal and vegetable fats and oils (AAFCO, 2008a).

Stickwater, fish: (Part) The aqueous extract of cooked fish free from the fat. Stickwater contains the aqueous cell solutions of the fish and any water used in processing (AAFCO, 2008a).

Stickwater, meat: (Part) The aqueous extract of meat free from the fat. Meat stickwater is the result of the wet rendering of meat products and contains the aqueous cell solution, the soluble glue proteins, and the water condensed from steam used in wet rendering (AAFCO, 2008a).

Stillage: (Part) The mash from fermentation of grains after removal of alcohol by distillation (AAFCO, 2008a).

Stover: (Part) The stalks and leaves of maize after the ears, or sorghum after the heads have been harvested (AAFCO, 2008a).

Straw: (Part) The plant residue remaining after separation of the seeds in threshing. It includes chaff (AAFCO, 2008a).

Sugar: Chemically, a monosaccharide or small oligosaccharide. Cane or beet sugar is sucrose, a disaccharide of glucose and fructose (Millamena, Coloso and Pascual, 2002).

Sun-cured: (Process) Material dried by exposure in open air to the direct rays of the sun (AAFCO, 2008a).

Supplement: A feed used with another to improve the nutritive balance or performance of the total and intended to be: (1) fed undiluted as a supplement to other feeds; or (2) offered free choice with other parts of the ration separately available; or (3) further diluted and mixed to produce a complete feed (AAFCO, 2008a).

Supplemental feed: Feed supplied to meet the nutrient requirement of fish for maintenance and growth when natural food is inadequate (Millamena, Coloso and Pascual, 2002).

Syrup: (Part) Concentrated juice of a fruit or plant (AAFCO, 2008a).

Tallow: (Part) Animal fats with titre above 40 °C (AAFCO, 2008).

Tankage: (Part) See carcass residue (AAFCO, 2008a).

Tempered, tempering: (Process) See conditioned, conditioning (AAFCO, 2008a).

Titre: A property of fat determined by the solidification point of the fatty acids liberated by hydrolysis (AAFCO, 2008a).

Toasted: (Process) Browned, dried or parched by exposure to a fire, or to gas or electric heat (AAFCO, 2008a).

Trace minerals: Mineral nutrients required by animals in micro amounts only (measured in milligrams per pound or smaller units) (AAFCO, 2008a).

Trash fish: Fish that have a low commercial value by virtue of their low quality, small size or lack of consumer preference. They are either used for human consumption (often processed or preserved) or used for livestock/fish, either directly or through reduction to fishmeal/oil (Funge-Smith, Lindebo and Staples, 2005).

Triglycerides: Esters of fatty acid and glycerol, the major form of storage lipids (Millamena, Coloso and Pascual, 2002).

Tubers: (Part) Short, thickened fleshy stems or terminal portions of stems or rhizomes that are usually formed underground, bear minute scaled leaves, each with a bud capable, under suitable conditions, of developing into a new plant; constitute the resting stage of various plants (AAFCO, 2008a).

Uncleaned: (Physical form) Containing foreign material (AAFCO, 2008a).

Unaponifiable matter: (Part) Ether soluble material extractable after complete reaction with strong alkali (AAFCO, 2008a).

Unsaturated fatty acid: Any one of several fatty acids containing one or more double bonds, e.g. oleic, linoleic, linolenic and arachidonic (Millamena, Coloso and Pascual, 2002).

Viscera: (Part) All the organs in the great cavity of the body, excluding contents of the intestinal tract (AAFCO, 2008a).

Viscera, fish: (Part) All organs in the great cavity of the body; includes the guts, heart, liver, spleen, stomach and intestines (AAFCO, 2008a).

Viscera, mammals: (Part) All organs in the great cavity of the body; includes the oesophagus, heart, liver, spleen, stomach and intestines, but excludes the contents of the intestinal tract (AAFCO, 2008a).

Viscera, poultry: (Part) All organs in the great cavity of the body; includes the oesophagus, heart, liver, spleen, stomach, crop, gizzard, undeveloped eggs and intestines (AAFCO, 2008a).

Vitaminize, vitaminized: (Process) To provide or supplement with vitamins (AAFCO, 2008a).

Vitamins: Organic compounds that function as parts of enzyme systems essential for the transmission of energy and the regulation of metabolism of the body (AAFCO, 2008a).

Water extract: The aqueous phase containing dissolved materials resulting from the treatment (e.g. by mixing or boiling) of a solid with water. All or part of the solid matrix may be dissolved in the extract (AAFCO, 2008a).

Wet: (Physical form) Material containing liquid or which has been soaked or moistened with water or other liquid (AAFCO, 2008a).

Wet-milled: (Process) Steeped in water with or without sulfur dioxide to soften the kernel in order to facilitate the separation of the various component parts (AAFCO, 2008a).

Wet-rendered, wet-rendering: (Process) Cooked with steam under pressure in closed tanks (AAFCO, 2008a).

Whey: (Part) The watery part of milk separated from the curd (AAFCO, 2008a).

Whey solids: (Part) The solids of whey (proteins, fats, lactose, ash and lactic acid) (AAFCO, 2008a).

Whole: (Physical form) Complete, entire (AAFCO, 2008a).

Whole pressed, whole pressing: (Process) Having the entire seed to remove oil (AAFCO, 2008a).

Wort: (Part) The liquid portion of malted grain. It is a solution of malt sugar and other water-soluble extracts from malted mash (AAFCO, 2008a).

Zooplankton: Small animals in water making up the secondary production level which depend on the water movement for locomotion (Millamena, Coloso and Pascual, 2002).

3.2 INGREDIENT CLASSIFICATION AND INTERNATIONAL FEED NUMBER

Feed ingredients can be coded and classified according to the “International Feed Vocabulary” of Harris (1980). The vocabulary is designed to give a comprehensive name to each feed ingredient as concisely as possible so as to avoid unnecessary confusion in ingredient identification. The feed ingredient name consists of up to six facets, separated by commas, and written in linear form. The six facets are:

- Facet 1 - Origin consisting of scientific name (genus, species, variety) and common name (generic name, breed or kind, strain or chemical formula);
- Facet 2 - Part fed to animals as affected by process(es) (i.e. actual part of the parent material fed);
- Facet 3 - Process(es) and treatment(s) to which the part has been subjected;
- Facet 4 - Stage of maturity or development;
- Facet 5 - Cutting (applicable to forages); and
- Facet 6 - Grade (official grades with guarantees).

For example, using the above nomenclature, Dong and Hardy (2000) named soybean meal and anchovy meal as follows:

- Soybean, Glycine max, seeds without hulls, meal, solvent extracted
- Fish, anchovy, *Engraulis ringens*, meal, mechanically extracted

Feeds/feed ingredients can also be further classified into one of eight classes depending on their proximate chemical composition and intended dietary use (NRC, 1983), namely:

- Class 1 - Dry forages and roughages, including hay, straw, fodder (aerial part), stover, hulls, and other products with more than 18 percent crude fibre (i.e. rice bran, seed coats, pods, etc.);
- Class 2 - Pasture, range plants and forages fed green, including all forage feeds either not cut (including feeds cured on the stem) or cut and fed fresh;
- Class 3 - Silages, including only ensiled forages (i.e. maize, alfalfa, grass, etc.) and excluding ensiled fish, grain, roots and tubers;
- Class 4 - Energy feeds, including products with less than 20 percent protein (dry basis) and less than 18 percent crude fibre (i.e. grain, mill by-products);
- Class 5 - Protein supplements, including products containing 20 percent or more protein (dry basis) from animal origin (including ensiled products) as well as oil meals, gluten, etc.
- Class 6 - Mineral supplements;

Class 7 - Vitamin supplements, including ensiled yeast; and

Class 8 - Additives, including antibiotics, colouring materials, flavours, hormones and medicaments.

Finally, each feed ingredient name can be assigned a six-digit international feed number (IFN) so as to facilitate identification and computer handling, with the first digit of the IFN denoting the feed class number. For example, the IFN of solvent extracted soybean meal and mechanically extracted anchovy meal is 5-04-612 and 5-01-985, respectively (NRC, 1983). For further information concerning the feed name description and IFN of individual feed ingredient sources commonly used in animal feeds (including aquafeeds), see AAFCO (2008b), Galano, Villarreal-Colmenares and Fenucci (2007), Hertrampf and Pascual (2000), NRC (1982, 1983) and Tacon (1993a, 1993b, 1994).

Despite the simplicity of the above nomenclature and feed reporting scheme, the large majority of published data concerning feed ingredient usage within aquafeeds more often than not fails to give full ingredient names and descriptions, including IFN. For example, listing an ingredient within an aquafeed formulation just as “fishmeal” or “soybean meal” is totally meaningless as there are literally scores of different types and grades of fishmeal and to a lesser extent of soybean meal, depending on the species and origin of the raw fish or bean and processing method employed. Clearly, full ingredient descriptions and nutrient composition data must be given if any meaningful conclusions are to be drawn from the results of dietary feeding trials.