

# Global View of Animal Feed in Halal Perspective

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## ABSTRACT

Islamic concept of food consumption for human beings is derived from the term Tayyib which depicts both food safety and quality. Unlike the humans, though animals are not bound to any code of practice, yet with reference to the food animals their diet seeks the attention of Islamic jurisprudence. Animal feed is the preliminary Halal control point in Halal food supply chain when the matter comes to the animal derived ingredients. This paper aims to put forth a global view of animal feed in Halal perspective by showcasing firstly the global scenario of feed industry, feed compositions, hazards, and regional regulations, secondly by highlighting the Halal and Tayyib integrity concerns over different feed compositions and addressing them through the global Halal standards and Islamic rulings issued by various Halal industry players. This research presents an interdisciplinary work of Islamic jurisprudence and feed science, which intertwines research on global feed compositions and the fundamental requirements of Halal and Haram jurisprudence. Animals are not the addressees of Quran and Sunnah; hence they are not bound to follow any code of religion. They are free to live and consume the way they like; in addition, Islam holds mankind responsible for their welfare and rights. Animal feed becomes an important subject for Islamic Jurisprudence only when the matter comes to the food animals. With reference to the food animals, animal feed is the preliminary control point of food supply chain, hence, it must be from halal source and must not cause harm to the human health.

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## 1. Introduction

Farm Animals have been a fundamental source to fulfill the multiple needs of mankind. They belong to kingdom ANIMALIA and comprise of mammals and bird which are deliberately raised for food, fiber, fertilizer, draft work and other similar agricultural purposes. The most common of these animals are cattle, sheep, goat, camel and poultry worldwide [1].

About 12,000 years ago inhabitants of fertile crescent which was an ancient civilized area extending between Mesopotamia, Assyria and some nearby Egyptian regions had begun to raise animal for getting their meat as food, bone for making tools, skin for making bags, fur for making cloths and for drafting and ploughing purposes [2]. It is quiet unknown how animals were fed intentionally or what could be their feeding system because the practices regarding the rearing

animal for food and services had occurred before humans learned writing. Moreover, during early stages of animal husbandry people mostly follow free range grazing of animal to fulfill their own family needs. The secure and reliable availability of food supplied from animals led human beings toward population growth, development of residencies, trade and economic and urbanization. From the birth of Prophet Christ enough food had been available for feeding world's population that was exceeding than a figure of 200 million [2]. Moreover, at the end of 18th century, sound and robust strategies for a fruitful agriculture had appeared which were causing a shift from subsistence farming practices toward commercial farming that in turn guided way for desirable feeding system around 19th century. As the time passes by, science and technology kept on progressing and improving techniques and methods resultantly animal husbandry embraces more efficient and dynamic form of technology and innovation. Thereby a road map toward evolution of feeding industry comes into being.

All living organisms require food to live and so do the animals. However, the term food is mainly associated to human beings and the word feed although defined slight differently by the standards of the various countries is on average is used for any food producing animals [3-6]. Hence feed is any material either in processed, semi-processed or in raw form when fed to animals furnish nutrition and upon digestion and assimilation of such feed which is utilized by body results in procuring energy, growth, development, reproduction and the maintenance and repair of body cells and tissues [3]

Basically, Animal feed is categorized as forage, fodder and mixed feed, which is a commercial feed that usually exist in the form of pellets or mash. The forages include non-processes plant material that is offered to animals in the form of pasture, crop remains and vegetation (cereals) grazing while fodder are the processed plant materials both as roughage which includes freshly cut grass, hay, silage, haylage or other similar things and as concentrates that includes cereal grains, legumes and other by-products resulted during their processing. Mixed feeds include both forages and fodder together with some other organic or inorganic materials called feed additives for achieving a particular objective such as nutritional quality and usually comes in mashed form or as pellet.

Earlier, evidences of feed dated back to 19th century were found, when animals were fed grounded grain. However, it was not a primary source but a secondary mean provided by early mills who were indeed installed for human consumption. In such case non-food or the leftover materials from these mills were fed to animals. Among cereals, oat raised cheap and less demand for humans at that time; hence it was specifically grown and fed to animals particularly horses. Although in the beginning of 1800 there were commercial opportunities for feed formulation but such was limited to horses and mule that were the mean of transportation and draft work in agriculture. They were reared separately in special houses called "stables" and such houses were like modern petrol stations [7]. The demand of feed for mule and hoses was also high and most of the biggest feed industries even existing today such as Cargill, ADM, Purina Mills and Ridley continued production of value-added feed while requiring less scientific expertise.

Late in 19th century feed formulation had begun to govern under feed standard. Massachusetts was the first region to be reported with batch method of feed manufacturing in 1870 [2]. But such manufacturing happened because the industry followed the first book written on animal nutrition by Armsby and Henry in 1880s [8], [9]. Cargill which was typically a flour milling industry begin to manufacture animal feed by 1884 after the corn gluten was manufactured for the first-time in 1882. Similarly, in 1894 Purina Mills entered the race of feed manufacturing. During 1890s, these emerging feed industries had utilized brewery as well as meat scrapes that were among the most nutritious by-products to be incorporated in feed manufacturing [10]. Besides, the birth of feed industrialization came into being when the first ray of 20th century's sun lit up the universe and of 19th century remained in memories. There were several background events that had caused such industrialization. One of such was the dumping of milling waste into water bodies. At that time, feeding animals a balance diet was also being recognized as valuable intervention regarding animal nutrition. The chemical analysis of such mill waste initiated the commercialization of feed industry [2]

Being the religion of love and affection Islam introduced a complete code of animal rights and welfare. Animals are the part and parcel of human society, therefore Islam held mankind responsible for their lives, feed and good treatment. Islamic jurisprudence does not proclaim any code of practice for animals, hence they are free to live and consume the way and whatever they like, but it is not the case when mankind is addressed. Islam has laid down a complete code of human consumption by decreeing the principle of Tayyib which encompasses food safety and food quality. Though the universe is crowded with living and non-living organisms but each and everything is not allowed for human consumption. There are certain restrictions Islam imposes on human diet. Since animals fulfill the multiple food needs of humans, hence their feed is vital in the preview of Halal (allowed) or Haraam (disallowed). With the industrialization of feed and commercialization of feed industry there are several doubtful and questionable ingredients in the context of Islam that are included to the composition of animal feed. In this piece of literature, animal feed would be discussed in halal perspective by summarizing firstly the global scenario of feed industry, different feed standards and regulations, multiple feed ingredients and feed hazards, then explaining the classical views of Islamic Jurists, latest Islamic rulings and global halal standards, and lastly by giving the outcome of whole discourse.

## 2. Materials and methods

This is a multi-disciplinary work stretching from important regional regulations to Islamic jurisprudence injunctions. To constitute the research on global animal feed in halal perspective firstly the global scenario of feed production was discussed along with the important regional regulations. These regulations were derived from multiple studies; each of them was referenced respectively. Then the Halal and Tayyib integrity concerns were highlighted along with the classical views of Islamic jurists. In the portion of integrity of Halal logo some crucial Islamic rulings and global Halal standards were discoursed to address those concerns and highlight the sanctity of Halal logo. Different terminologies from Islamic Jurisprudence were used, like, Hadith means sayings of the blessed Prophet (P.B.U.H.), Halal means allowed, Haraam mean disallowed, Makrooh means bitterly disliked, Najis means filthy in the eye of Islamic jurisprudence, Tayyib means safety and quality. The reference Hadith books including Sunan an-Nasa'I, Sunan Abi Dawud and Sunan Al Tirmidhi were used for Hadith derivation along with their relevant Hadith number. Some revelations from Quran, the book revealed to the blessed Prophet Muhammad (P.B.U.H.) were also sited with their respective numbers.

The material presented here is referenced to the multiple journals, books and a few reports written by international organization belong to animal feed industries. The paper is divided under various headings related to animal feed industry and its halal perspective describing about the history, technological advancement in feed and feeding system, concept of Halal and Tayyab in animal feed, Islamic jurisprudence about animal feed and a few feed borne diseases of importance to farm animals. The journals which have been referenced are Journal of Applied Animal Nutrition, MOJ Food Processing & Technology (MOJFPT), Engineering, Research Journal of Agricultural Sciences, Journal of Nutritional Health and Food Engineering, Environ Health Prospect, Aquaculture, Journal of General Internal Medicine, Environmental Science & Technology, Bulgarian Journal of Agricultural Science, Journal of Environmental Science and Technology, Journal of Animal Science and Biotechnology, Nutrition Research Reviews, Emerging Infectious Diseases, Clinical Infectious Diseases, Poultry Science, American Journal of Food Science and Nutrition, Toxins, Asian Journal of Animal Sciences, Toxicon, Animal Feed Contamination, African Journal of Food Science, Proceedings of the Nutrition Society, Journal of Nutrition, Veterinary & Human Toxicology, Chinese Journal of Animal Nutrition, Nutrition, Aqua feed Formulation, Aquaculture Research, Animal Feed Science and Technology, Molecular Nutrition & Food Research, Veterinary Record, British Medical Bulletin, Cerebellum, Asian-Australasian Journal of Animal Sciences, and Preventive Medicine.

Among the books from where material has been taken are Principles of Animal Nutrition 3rd Edition (1908), Feed Manufacturing Technology 5th Edition (American Feed Industry Association, 2005), Feeds and Feeding (1988), International Directory of Company Histories (James Press,

2000), Recent Developments in Feed Technology (Ferket and Stark, 2011), The Formula Feed Manufacturing Industry (USDA, 1988), Handbook of Naturally Occurring Food Toxicants (Langer, 2018), Handbook of Zoonoses: Identification and Prevention (Colville and David, 2007), and Contemporary Issues and Development in the Global Halal Industry (Saidin and Rahman, 2016).

### 3. Global Scenario of Feed Industry

According to Alltech, which is a globally recognized organization conducting surveys on animal feed industry, the feed industry has come out with great productive potential and exceeded a figure above 1 billion metric ton [11]. Among the North American region, which is the second largest producer of feed worldwide, two countries Canada and USA dominated feed industry particularly the horse feed industry in the region [12]. The region produces about 1/3 of feed for beef production while the prices are usually lower as compared to other regions and growth rate is almost flat. In the Latin America, three countries; Brazil, Mexico and Argentina cover 75% of total regional production. Brazil, which is World's 3rd largest feed producer enjoys leading role in the production while Mexico, which is 5th largest leads the regional feed production for beef and layer. The region's growth rate remained 3rd highest for more than five years mostly in aqua, horses and pet feed.

Europe is one of the fastest growing regions in the feed production and has been accounted for about 3% of feed tonnage growth. The reason behind the growth is increased production of aqua and boiler feed. Regional feed production is dominated by Russia which is 4th largest feed producer and has produced 37.6 million tons feed during the year 2017. The other European countries contributing in feed production are Czech Republic, Poland, Hungary, Belgium, U.K., Ukraine and Romania. The region also remained the top pet feed producer.

Asia-Pacific region is the leading feed production zone in the world contributing 35 % of global production. The dominating country is China. Although the China's growth rate of feed production was declined during the last 2 years but remained as top feed producer and produced 186.86 million metric tons feed in the year 2017. There has been 3% increase in regional feed growth rate resulting from increased pet feed production. The region also covered 77% of aqua and 44% of layer feed production globally. Other countries contributing in the feed production are India, Thailand, Pakistan, Japan, Taiwan and Vietnam.

Likewise, Asian region, Africa also contributes progressively to feed production especially to broiler and dairy feeds. Although the region remained expensive for feeding layers and broiler, it has achieved a growth rate near to 30% for more than the last 6 years. The region also enjoyed the maximum increase in growth rate of about 10% in broiler feed. Among the contributing countries are Egypt, Botswana, Mozambique, Zambia, Morocco, Nigeria and Uganda [13].

#### 3.1. China Feed Industry

China which is the largest country in terms of population, also keeps the similar position in feed industry [14]. In the early days, wheat bran from the modern flour mills operated since 1930s was utilized by farms to feed their animals. For the next 19 years starting from 1930s to 1949, no single feed mill was established in the country. Moreover, in the following years political chaos along with the retarded economy and centralized governmental system caused the grain production to be carried out exclusively for human's consumption. As a result, the potential for establishing the feed industry was hindered.

It was 1976 when dawn of the new era started dazzling china. A transition happened in Chinese policy building by global trading and adopting new ideas and technological development from other regions of the world. This transition gave a complete potential chance to build feed mills. During 1976, feed research institute was established. By the following year, the ministry of commerce was also assigned a duty to do research over the methods and strategies followed by Japanese, French and American feed industries [15]. Consequently, 14000 mills were built up to 1985 including both large and small mills with an installed capacity of <1 ton/hour. During 1984, a draft plan was developed and published to support goals and strategies for a period of 16 years starting from 1984 to 2000 [15]. Meanwhile, government provided incentives and suspended

imposition of taxes on the feedstuff, feed processing equipment along with 3-year tax adjustment for the new mills and allowed tax free profit [16]. The initiative was much more welcomed by the industries. 2 years later in 1986, specialized feed ingredients and supplementations were presented at a national level conference. Resultantly, about 12 products got approval for the year 1987. Within a decade, compound feed became the new focus and led the production up to 62.99 million tons during the year 1997 [17].

The ministry of commerce published China's first feed standard in the year 1993, while the regulations regarding the development of mixed or compound feed, packaging, storage and transportation of feed came in the year 1996. Unfortunately, only about 10% of the industries qualified against the standards [15]. Therefore, State Council, LAO had made enactments in the regulation of feed and the feed additives in the year 1999 [18]. From that time, Chinese feed industry faced severe safety concerns for their feedstuffs. Resultantly in 2007, the presence of melamine and cyanuric acid in pet feed, which were deliberately used to give high content of crude protein, resulted in kidney failure in animals. This had elevated serious issues for the feed industry causing the recall of their feed by South Africans, Europeans and Americans. Moreover, USDA had made it mandatory to inspect any sort of plant proteins which were to be imported from China. Chinese officials had tried hard to resolve the problem and allowed U.S. FDA for inspection of their premises and facilities. In the period 2008-2009, more focus was shown on feed adulteration and the associated crises. Hence, during 2010, a revision was done in feed and feed additive regulation [18]. The period starting from 2010 to 2015, showed an annual growth rate about 15% which was enough to declare the china as the largest feed producer of the world [19]. But still China had to import soybean and distiller's dried grains or DDGs in significant amount [20]. Beside this, China has focused the attention to put the country on track of self-reliance thereby avoiding western and other imported items [21-22].

### 3.2. U.S. Feed Industry

The advancement in the U.S. feed industry came by the 20th century [2]. The need of industrialization though resulted from establishment of farms, was significantly supported by allied factors such as the use of synthetically prepared fertilizers in 1990 that resulted in increased crop yield [2]. This has further contributed a great deal of specialization and expertise in crop and as well as livestock production, paving the way for feed industry to flourish. During early periods before 1900, hammer mills were used to produce feed while by 1909, horizontal batch mixers came. Rapid progress had been seen during 20th century's first quarter but the whole industry became reformed after the introduction of feed in pellet form by Purina Mills in 1920s. This technique usually involves the compressing of fine, variably dense, and unappealing feed ingredients into more uniform, palatable and easeful pellets. Mostly it was adopted by the industries and as a result by 1930s, most industries excelled in producing pelleted feed.

Traditionally, Chicago and Minneapolis had hosted feed mills. Companies running the business of milling had excessively been producing animal feed by utilizing the by-products resulting from the milling operation thereby avoiding their disposal for profit. In early formulations milling by-products were blended with nutrients. Between 1940s & 1950s, rapid progress in science and technology was seen, thus, making feed formulation more complex than before by incorporation of essential vitamins, trace minerals, and other antibiotics. At the sometime, the industry progressed from milling companies to exclusive feed firms reaching above 2000 in numbers throughout the country. Leaving the feeding hubs, small feed industries also stepped toward producing newly complex feed formulation through utilization of batch mixer near the farms. This sort of transitional step opened way for more specialization and resulted in extruded pet feed during the mid of 1950s.

The improvements and technological reforms consolidating the feed industry had continued to occur till the end of 1950s. The period ranging from 1960-1970s, showed the establishment of large feed mills alleviating normal production about 200-500000 tons yearly. Another trend was also being seen in which large farms or the feedlots started to build their own feed mills in an attempt to be more competent. Although, the trend had caused reduction in number of farms but the existing ones became multiplied in size. Resultantly, in 50 years from 1950s to 2000, five million farms



declined to about 2.2 million. By 1975, focus toward automation of the industry was also carried out with the main aim to increase efficacy of feed production while reducing the cost of feed per animal unit. The automation technology continued improving various element of the feed industry some of which are logistics of receiving and delivering ingredients, size and grounding of ingredients, batch mixing or other method, control of the process, extrusion technology and pelleted feed formation etc. [23]. Consequently, the technology became much more diversified over the last 5 decades leading to completely computerized system of operation, analysis of nutrients by in-line NIR system and well-organized collection of data inside the feed.

### 3.3. Brazil Feed Industry

Since 1960, Brazil feed industry has been producing animal feeds and has become third largest feed producer of the world [14]. Just like US and European feed industries, Brazilian companies that were doing milling and processing of wheat, maize and barley became the early feed industries of the country. In 1940, wheat bran was used by early feed industries to produce animal feed as such or for incorporation as an ingredient to make a complete feed for the first-time. Resultantly, in the year 1941 a feed mill was established in Sao Paulo particularly to fulfill layer production that was in its growing stage. With the passage of time demands became higher and higher, thus another feed industry named cooperative's feed mill entered the path to fulfill country needs especially for meat and broiler production.

The interesting feature of Brazilian feed industry which is normally integrated with production is that the feed is produced by and fed to animals by the same company. This level of integration is highest among the poultry feed about 99% while about 80% for all feed types [2]. Additionally, most Brazilian feed industries are linked to each other. The former employees of Purina Mills had established Mogiana or Guabi feed company in 1974. Within 6 years, Mogiana attained significant share in the market even transcending then its parent company Purina. The executives of Mogiana left the company and established Nutron after a period of 16 years in 1990s. Currently, pet feed industry escalated Brazil to the second largest slot across the globe. Although, before 1990s the pet feed industry was hard to find, the introduction of extruder together with improvement in techniques and equipment made Brazil to prosper about 25 times more productive than before within 25 years. Moreover, being leader in production of maize, soybean and other feed ingredients, the future of Brazilian animal feed industry is more promising than the others.

## 4. Feed Ingredients

The study of animal nutrition and feed science has been divided into two sections. The first section focuses upon the nutritional requirements while the other on the availability of these nutrients both naturally in plants and animals and artificially or synthetically [24]. These essential nutrients are classified into macro nutrients and micro nutrients. Among the macro-nutrients are carbohydrates and fat for energy or draft work and protein for growth, development and maintenance. On the other hand micro-nutrients include minerals, vitamins, antibiotics, and others play vital role in the metabolism and utilization of macro-nutrients by the animals. For a balanced supply of feed to fulfill animal requirements, scientists in their respective research organizations have formulated their own sets of standards and regulations for each nutrient and specie's type. Feed ingredients are not only derived from plants and animals but also from pharmaceutical and other sources described as follows.

### 4.1. Plant Based

Among the plant based materials used to develop the feed are forages, roughages, by-products of milling and sugar-cane processing in the form of molasses, brewery industry in the form of DDGs, fruit and other similar food and non-food industry [4].

### 4.2. Animal Based

There are certain Ingredients used in manufacturing of feed are significantly derived from animals. These ingredients are legally used to manufacture the feed worldwide and are rendered protein meals and dried waste [25]. The rendered protein comes in the form of meals of meat, blood,

feather, eggs shells and hair of poultry, swine and ruminants while the dried wastes of poultry, swine and ruminant are used either in dry processed form or as non-dry processed form. Apart from these, by-products of marine industry also provide valuable feed ingredients in the form of fish liver oil and meals of fish, crabs and shrimps [26]. Dairy industry also contributes its share in the form of dried milk, casein, whey and cheese [27].

#### 4.3. Mixed

Apart from the individual incorporation of ingredients from animals and plants combination of these from the two aforementioned sources are also being used. Such a case includes used animal or plant fat, leftovers from restaurants, bakeries, and cafeterias and the contaminated food that has been subsequently treated to make it suitable for feed manufacturing [28].

#### 4.4. Miscellaneous

These include the ingredients that are required for the maintenance and regulation of body functions and to promote growth and development. These are antibiotics, vitamins, enzymes, additives, nutraceuticals, preservatives, drug industry by-products, Arsenicals and Non-protein Nitrogen or NPN [29,4].

### 5. Conclusion

After an overview of the globally manufactured feed, its ingredients, global standards and regulations, the Halal and Tayyib integrity concerns, different views of classical Islamic Schools of thought, sanctity of halal logo, global Halal standards and the concept of Jallalah, following points are concluded as findings of this whole discourse. The following points are in-line with the halal certification to ensure the integrity of the halal logo on animal feed. The classical juristic adjudication on the other hand professes softer and easier outcomes as has been stated earlier.

Animals are not the direct addressees of Quran and Sunnah, therefore, they are not supposed to follow any code of religion. They are free to live and consume the way they like; in addition Islam holds mankind responsible for their welfare and rights. Animal feed becomes an important subject for Islamic Jurisprudence only when the matter comes to the food animals.

Islamic Concept of food is based upon Tayyib (food safety); therefore, any ingredient in animal feed which resultantly causes hazards to human health shall be deemed non-halal. The burden of responsibility to affirm anything injurious to health lies on the shoulders of feed scientists and the concerned experts.

All the mineral based feed ingredients are halal unless held hazardous to human health, hereafter; di-calcium phosphate, marble powder, limestone etc. may be used in the manufacturing of animal feed as long as these are not considered injurious to human health.

Fundamentally all the agro based feed ingredients are halal unless deemed hazardous to human health. Distillers' dried grains with solubles (DDGS) that come as a byproduct of alcoholic beverage industry shall be held non-halal.

Ingredients derived from aquatic animals for animal feed are halal unless held hazardous to human health. In this regard, fish meal is rendered halal.

Ingredients derived from amphibious animals for animal feed are held non-halal.

Ingredients derived from halal terrestrial, or Ariel animal being slaughtered in compliance with Islamic slaughtering rules are halal to be used in animal feed except blood. Blood derived ingredients are held non-halal. Ingredients derived from other than halal animals or from halal animals not slaughtered in accordance with Islamic rules shall be considered non-halal. In this regard, blood meal is rendered non-halal, while bone meal and meat meal derived from the halal animal with the said condition are deemed halal. Same is the case in poultry by-products meal, only halal slaughtered poultry by-products meal is rendered halal with the exception of blood. All these ingredients are deemed halal provided that they must not cause harm to the human health.

Jallalah animals shall be kept under quarantine process prior to consumption.

To conclude the whole discourse, it can be asserted that the feed of the animal must be from Halal source and is of such nature that it must not cause harm to the animal and resultantly to the human being.

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### Conflict of interest

The authors have no competing or conflict of interest.

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