



Feed Additives, Residues and Contaminants in Animal Health and Productivities: A Review

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Abstract

In the intensive livestock production systems, with decrease in grazing land and intensification of agriculture, the animal feeds are most likely to be contaminated with pesticides, drug, feed additives, dioxins, radionuclide, heavy metals, bacterial, fungal mycotoxin contaminants and residues. The feeds and fodders are cultivated in lands which are devoid of heavy metals, radionuclide, industrial wastes, dioxins and other contaminants. The feeds are to be protected from bacterial and fungal contamination from the time of harvest till the animals consume it. The newer feed ingredients are to be used only after they are tested free from anti-nutritional factors, contaminants or toxins. Organic foods are gaining importance for human of avoiding contaminant, pesticide, drug and any residues in the livestock products. As the contaminants can enter the food chain at any stage of livestock production system, a collective and concerted effort is required from agriculture, animal husbandry, feed industry, animal production and food industry experts to give quality and safe foods and free from any contaminant to the consumers. Presence of any residues in feeds and fodders affect the feed intake, nutrient utilization and consequently the production and health of the animals. Some contaminant chemicals undergo biotransformation and are degraded into a variety of metabolites to be stored as residues in body tissues and fluids of animals which are causing some health problem when used for the human consumption.

Keywords: Feed Additives; Toxins; Residues; Contaminants; Productivities

Introduction

Livestock production is growing fast as a result of increasing demand for animal Product. To satisfy the demand and to confer economic uses to the producer, the animal production systems have become a lot of intense and passionate about the utilization of growth promoting substances, antibiotics and newer feed ingredients. In recent years and in several countries, public concern regarding the protection of foods of animal origin has heightened because of the issues of contamination, outbreaks of food born microorganism infections, furthermore as growing concern regarding veterinary drug and agricultural chemical residues and microorganism resistance to antibiotics. These issues have drawn attention to feeding practices at livestock industry and have prompted health professionals and also the feed market to closely

scrutinize food quality and safety issues that may arise in foods of animal origin as a results of animal feeding systems. To satisfy consumer demand is not only in amount produce however it should be also quality of the product. Livestock product (meat, milk, eggs and their product) should be produced from disease free animals, beneath hygienical conditions and free from any contaminants and residues. The standard of animal feed and forage and their potential impact on human health begin with the growing and harvest of feedstuffs within the farmer's field and during feeding of the animals [1].

Foods are produced by living organisms, either plants or animals; therefore, the atmosphere wherever the food producing organisms grow, together with the feeds used for food producing animal are very important for the quality of our diet. Feeds should

satisfy the biological process needs of the relevant food producing animal species. Moreover, feed composition within the industrialized world, yet as in a very growing fraction of developing Countries, ought to support efficient and timely production of meat, egg and milk by best producing breeds [2]. In the meantime, the requests of customers for foods with a given flavor, texture or color have to be considered. Besides the chemical composition and their possible contaminant, feeds utilized in intensive farming need of a various type of additives, alike human foods throughout the industrialized world. In fact, feed additives create the majority of chemicals that has been used in animal production, therefore representing a significant issue for safety foods of animal origin. As set down by the European Commission regulation they are varies and heterogeneous cluster of compounds used to feeds because of their importance like vitamins and trace components, zoo-technical like growth promoters and coccidiostats, sensory like colorants and flavors or technological like antioxidants, preservatives and emulsifiers role furthermore, the increasing importance of enzymes and microorganisms as probiotics ought to be taken under consideration. Such a various type of compounds board variety of specific problems besides the overall objective of guaranting that attainable residues in animal product wouldn't create any considerable risk to consumers [2].

Type of contaminants

Contaminant could be a substance that is not added directly to feed, however it is found in a feed as a results of production, manufacture, process and preparation of feed, treatment, during transport or storage of such feed or as a results of environmental contamination. The term harmful or anti-nutritional issue is often used once concerning those substances found in feeds that affect as a result on consumption by animals. In general, the term implies to those substances that are fatal on beyond a given level and on prolonged consumption produces adverse physiological responses. Animal feeds and forages are often contaminated with a variety of contaminants which are environmental contaminants, microorganism contaminants, fungal contaminants, mycotoxins, plant toxin, weed seeds, animal toxins, feed additives and growth promoting hormones.

Environmental contaminants

A wide vary of organic and inorganic compounds are found in feedstuffs, together with pesticides, industrial pollutants, radionuclides and heavy metals. Pesticides which will contaminate feeds

originate organochlorine, organophosphate and pyrethroid compounds [3]. Pirimiphos-methyl is as insecticides in grain stores, though pesticides are contaminant and toxic to farm animal, the first focus of concern is residues in animal product which indirectly has effect for human consumption. Dioxins and polychlorinated biphenyls are the most common industrial pollutants which will contaminate animal feeds. Cows grazing on pastures around industrial area produce contaminated milk with dioxin than cows from rural farms.

Contamination of feeds and grazing area with cadmium contaminant occur as a results of utilization of varieties of fertilizers to crops and grazing area. Also lead contamination arises from industrial and urban pollution, whereas mercury in feeds arises from the utilization of fish meal [4].

Pesticide residues

Pesticides are chemicals that either kill pests or inhibit their development. They are usually classified according to the pest they are intended to control. Pesticides including chemosterilants and growth regulators, that affect the normal reproduction and development of the pest. To boost the production different types of compounds are used in the farm. Presence of residues of pesticides in feeds and fodders have an effect on the feed intake, nutrient utilization and as a result it affects the production and the wellbeing of the animal. The pesticides undergo biotransformation and degraded into a range of metabolites to be hold as residues in body tissues and fluids of animals will be then public health concern if it is consumed. Use of pesticides and different harmful chemicals like insecticide repeatedly on crops will cause cancer, sterility and diseases of the liver in animals. Toxins like DDT will diffused and hold in animal fat. Among the pesticides chlorinated hydrocarbons (aldrin, endrin, dieldrin, heptachlor, toxaphene, etc.) are the worst perpetrator [1].

Nitrates

The incidence of nitrates in crops is favored by the application of extremely soluble mineral fertilizers. The negative food safety implication of high nitrate content in foods is that beneath certain conditions they converted to nitrosamines which are carcinogenic. Nitrates can even impair the potential of the blood to hold oxygen, and will cause a risk of methemoglobinemia. This phenomenon is very common in forages where the nitrogenous fertilizers are used at maximum dose or when the forages are harvested at very early stage.

Veterinary medicine residue in animal production

Some veterinary medicines which used to treat animals will leave residual contamination in meat, milk and in their product and sometimes result acute food poisoning sickness, allergic condition and the event of antibiotic resistant microorganisms which is concern to human health. Although the bulk of studies indicate that antibiotics don't increase microorganism load but repeated utilization of antibiotics might contribute to the prevalence of antimicrobial resistance [5]. Antibiotics like sulphonamides, chlortetracycline penicillin and ionophores are amongst the foremost widely used antibiotic. However recurrent consumption of these antibiotic residues in food might contribute to the event of antibiotic resistance therefore reduce their efficacy while when used in treatment of diseases. Producers should adhere to withdrawal periods before the animals is sent to slaughter house and food processor.

Contamination from natural fertilizers

Animal manure and alternative organic waste are the most fertilizers used in organic farming. These natural fertilizers are also widely used in conventional agriculture with chemicals synthesized fertilizers. Microbiological contamination arising from the utilization of natural fertilizers in the farm [1].

Radionuclides

The accidental releasing of radioactive material from nuclear energy plant could be a well-known drawback and has terribly serious implications for the human population and for animals as well both for domestic and wild animals.

Heavy metals

Pollution of pasture and alternative farm land with significant heavy metals might occur either speared from smelting plants and following speared of industrial processing plant, or the spreading of human and animal waste (sewage sludge, manure and slurry) on to land [6]. In each circumstance these heavy metals is eaten by animals while grazing the pasture or when feeding conserved and stored forages and these metals might later pass to the human population though consuming meat or alternative product of animal origin. The cadmium, mercury and selenium are extremely deadly toxic metals found within the animal feeds

Bacterial contaminants

Currently there is public health interest with the incidence of *escherichia* in animal feeds following the association of

the O157 type of these bacteria with human illness [7]. Replication of fecal *E. coli*, including O157 type, was demonstrated in different type of feed of cattle farms during summer months. Since fecal contamination of feeds is widespread on farms, it is an important route for exposure of cows to *E. coli* and other organisms. The potential for exposure to microorganism exists when poultry litters are use as animal feed. The potential pathogens bacteria are transmitted to human through the food producing animals. However, providing by adequate heat treatment before distribution will reduce the risks of contamination with *E. coli*, *salmonella* spp and *Campylobacter* spp are likely to be reduced or maybe eliminated [8]. *Listeria monocytogenes* tends to occur in poor quality ensilages and big-bale silage. Once grass is ensiled below anaerobic conditions, the low pH condition ensures that *listeria* is excluded from the ensuing ensilage. However, in big-bale silage a degree of aerobic fermentation might occur and the PH is raised and permitting the development of the *listeria*. These bacteria survive at low temperatures and in silages with high levels of dry matter. Contamination of silage with *listeria* is common and it causes abortion, meningitis, encephalitis and septicemia in animals and humans [1].

Bacillus anthracis

Spores of *B. anthracis* are capable of persisting for long periods within the environment and in contaminated animal feed, especially meat and bone meals prepared from animal died by anthrax infection. There is chance that humans infected by anthrax from meat and milk and there also cases of anthrax in those who consumed meat from animals that have died from anthrax.

Bovine spongiform encephalopathy disease

WHO counseled that because of this disease no part or product of any animal that has shown signs of a mad cow disease should enter any human or animal food chain.

Salmonella

Animal feed ingredients of plant or animal origin are a chance of contaminated with salmonellae which is the most common serotypes isolated and the major source of infection to animals as well as human [9].

Fungal contaminants

There are repeated reports of worldwide contamination of feeds with fungi and their spores. within the tropics, *Aspergillus* is the common genus in dairy farm and in animal feeds [10]. Differ-

ent species like *Penicillium*, *Fusarium* and *Alternaria*, are the common contaminants of cereal grains [11]. This fungus contamination is undesirable because it produces mycotoxin. However, spores from moldy fodder, silage, brewers' grain and sugar-beet pulp is also inhaled or consumed by animals with harmful effects termed "mycosis". Mycosis condition may occur in cattle and cause mycotic abortion which is as a result of systemic infection and proliferation in placenta and fetal tissues.

Mycotoxin

Mycotoxins are those metabolites product of fungi that have the capability to affect animal health and productivity [12]. The effects caused by these compounds are conventionally called as the generic term "mycotoxicosis" and embody distinct syndromes additionally as non-specific conditions. Contamination may occur throughout feed process and storage of harvested product and feed whenever environmental conditions are suitable for spoilage fungi. Feed wetness and appropriate temperature are the main condition determinants for colonization and mycotoxin production. Conventionally toxigenic fungi subdivide in to field or plant pathogenic and storage or saprophytic spoilage organisms. *Claviceps*, *Neotyphodium*, *Fusarium* and *Alternaria* are classified under field fungi whereas *Aspergillus* and *Penicillium* represent storage organisms.

Aflatoxins

This cluster includes aflatoxin B1, B2, G1 and G2 (AFB1, AFB2, AFG1 and AFG2 respectively). Additionally, aflatoxin M1 (AFM1) has been known within the milk of dairy cows which is produced when the cow consuming feed contaminated with AFB1. The aflatoxigenic *Aspergilli* are typically considered as storage fungi, which is produced and proliferate under conditions of high moisture and temperature. This aflatoxin contamination is, therefore, completely confined to tropical feeds like seed by-products derived from groundnuts, oilseed and palm nut. Aflatoxin contamination of maize is additionally a problem in warm wet regions wherever *A. flavus* might infect the crop before harvest and stay viable throughout storage [1].

Ochratoxins

The *Aspergillus* genus includes a species *A. ochraceus* that produces ochratoxins, this toxin shares with at least two *Penicillium* species. Ochratoxin A (OA) and ochratoxin B are the most two form that occur naturally as contaminants, with Ochratoxin

A being more common occurring in cereal grains and within the tissues of animals which are consume contaminated feed. Another mycotoxin, citrinin, usually occurs together with ochratoxin [1].

Effect of mycotoxins on animal health

Mycotoxins will cause different type of health issues in farm animal specially in cattle and sheep, which reduced feed intake, reduced nutrient absorption, affect metabolism, changes hormone secretion and suppressed immune system, all these with a negative impact on animal performance. The severity of symptoms will be depending on the kind of phytotoxin, the quantity consumed and therefore the length of exposure. Contaminated batches of feed will contain variety of mycotoxins. This, combined with the actual fact that mycotoxins are usually inconsistently distributed throughout the feed, will create it troublesome to pinpoint the precise inconsistently distributed throughout the feed, can make it difficult to pinpoint the exact effect a particular mycotoxin will have on an animal, since they may be exposed to many mycotoxins at a time. It's thought ruminants are less vulnerable to mycotoxins than other species, as a result of the ruminal bacteria will degrade can degrade some of mycotoxins and keep the animal from being infected. However, some phytotoxins will resist to less breakdown and prolonged ingestion to different mixture of mycotoxin will affect the normal function of stomach microbes [1].

Plant toxins

Toxic compounds are found within the plant part or seeds which can be used as animal feed [13]. Plant toxins can divide into a heat-labile type comprising lectins, enzyme inhibitors and cyanogens which are temperature sensitive during processing. Heat-stable type which are antigenic proteins, condensed tannins, quinolizidine alkaloids, glucosinolates, gossypol, saponins, the non-protein amino acids S-methyl cysteine, sulphoxide and mimosine, and phyto-oestrogens.

Weed seeds

Contamination of weed seeds with animal feeds is also problem in livestock world. The impact of weed seeds arises from the toxins they contain and from their diluent effects on nutrient density of feeds. The toxins include alkaloids, saponins, amino acids and proteinase inhibitors. *Datura* spp., common vetch, castor oil plant and *crotalaria* spp are the examples of weed seeds contamination.

Animal toxin

The particle proteins of meat and bone-meal have recently emerged as potential feed contaminants. Prion proteins are harmless the smallest animal body part component which has the potential to transform itself in to agents and ability causing very dangerous neurological lesions in different farm animal species. The onset of this sickness was attributed to the feeding of cattle with meat and bone-meal prepared from the carcasses of scrapie-infected sheep. This type of disease is also developed from prion protein particles as it is the same to human new variant Creutzfeldt-Jakob disease (vCJD). The incidence of vCJD in humans has been connected to the consumption of BSE infected beef. This association demanding the public health important legislation in the European Union concerning the utilization of animal by product in animal feeding [1].

Feed additives

Besides ingredients and their potential contaminants, livestock feeds utilized in intensive farming need the adding of a different type of feed additives, alike human foods throughout the industrialized world. In fact, feed additives build the majority of chemicals utilized in animal production, thus representing a significant issue for safety of human foods produced of animal origin. As arranged down by the European union regulation they are an outsized and heterogeneous cluster of compounds added to feeds because of their nutritional use (vitamins, trace elements), zootechnical (such as growth promoters, coccidiostats and anti-black-head compounds), sensory (colourants and flavours) or technological (antioxidants, preservatives, emulsifiers, etc.) role; additionally, the increasing importance of enzymes and microorganisms as probiotics taken under consideration. Such a various range of compounds entrain variety of specific issues besides the final objective residues of these feed additive in animal product would not create any considerable risk to the consumers [2].

Risk of feed additives utilization

The “farm-to-fork” approach promoted by the European Union needs the assessment and management of major elements of the food production chain, with stress on primary production. Consequently, Europe has given a big attention to the assessment of feed additives that shall be based on the three principles. The first one is pre-market authorization, the second one is positive list principle and thorough evaluation of potential effects on human and animal

health additionally on the surrounding environment [2]. Evaluating a feed additive may be advanced method that needs a comprehensive, multidisciplinary approach to assess all aspects relevant to use of a given substance. Compounds used in animal feed ought to have a tested for its potential to boost production ought to be safe for animals and customers at the supposed dose levels and its safety for the user ought to be assessed additionally its ecotoxicity should be known. Mass use of these feed additives in intensively farmed livestock might cause a big environmental contamination through animal excretion.

Growth promoting hormones

The use of hormones like steroid hormones, beta-agonists and somatotropins are criticized as growth promoters and their use may affect animal health and there is also welfare risks and it has ethical consideration. The use of growth hormones for growth promotion in cattle raise a risk of public health concern but there is different level of conclusive proof. This is often the most finding of the Scientific committee for veterinary measures regarding public health that has solidly adopted associate potential risks to human health from hormone residues in meat and meat product. The adverse effects include developmental, neurobiological, genotoxic and carcinogenic effect. These effects are attributed to either the parent compound or the metabolites. There is recent evidence that natural hormone 17 β -oestradiol is the main cause of carcinogen problem. It produces both tumor initiating and tumor promoting effects. Estrogen hormone binds to the estrogen receptor in the body of animal and promote cancer cell development and growth by transcriptional regulation of genes involved in cell proliferation. Cancers linked to the presence of estrogen include breast, endometrial and ovarian cancer

Conclusion

The feed industry and the animal production industries have to be recognized the important use and role of feed additives, new ingredients and processing methods in the production of safe food and should intensively assessed the consequences to public health. As quality assurance is applicable at all stages of food production to ensure the safety of the consumer by the concerned regulatory body, a code of practice for safety animal feeding should be followed. Manufacturers should provide adequate information to enable the quality and safety of feed to be maintained after delivery. Known and potential risks associated to food safety should be asse-

sed as new information becomes available. Use of any input in feed of animal or animal production process requires a careful evaluation with the support of contemporary scientific information, in order to evaluate their potential and safety in the modern farm animal production. Feed contaminants are an unavoidable problem, but they can be reduced by good farming management practices, including the development and use of nutritional sources product that are less liable to potential contamination. This would support the definition of optimum types and levels of feed ingredients and additives, thus helping to reduce the burden of farm animal diseases and the consequent use of veterinary drugs, with the ultimate result of increasing safety of the food chain.

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