

# Oxidative rancidity in poultry feed

*Under hot and humid conditions, feed without antioxidants is subject to oxidative rancidity, which can lead to symptoms of vitamin deficiency in the birds.*

**—Dr A A Qureshi**



Adult birds with eye lesions of panophthalmitis due to chronic vitamin A deficiency caused by oxidative rancidity in the feed

The nutrient requirements of poultry are quite complex because of their relatively simple intestinal tract and little support from intestinal microflora. There are requirements for more than forty so-called “essential” nutrients in feed, including amino acids, vitamins and inorganic chemical elements as well as water, oxygen and energy. A balanced feed formulation in developing countries can require more than a dozen ingredients to achieve the requirements for the various nutrients, e.g. crude protein, crude fat, crude fibre, calcium and phosphorus. Typically, a feed formula will comprise 60-65% cereals including wheat, rice, sorghum and a little maize together with one or more oilseed meal with a high fat content. Table 1 shows the basic nutritive composition of some common indigenous feed ingredients.

**Table 1 Composition of some local feed ingredients**

Ingredient	Crude protein (%)	Crude fat (%)	Metabolisable energy (kcal/kg)
Broken rice	5.8 - 9.0	1.6 - 4.8	3470
Sorghum/milo	7.5 - 10.4	0.8 - 4.2	3400
Rice bran	6.5 - 9.0	3.6 - 8.4	1670
Rice polish	9.8 - 12.6	8.5 - 12.0	2920
Wheat bran	13.0 - 16.8	3.0 - 7.3	1670
Sesame cake	32.5 - 42.5	5.2 - 9.8	2420
Cottonseed cake (mech. extr.)	26.6 - 39.7	5.9 - 11.0	2250
Cottonseed cake (solvent extr.)	35.7 - 45.5	1.1 - 4.2	1970
Sunflowerseed cake	30.0 - 32.8	10.0 - 11.1	2520
Linseed cake	35.5 - 38.8	8.5 - 10.5	2070
Fishmeal (low grade)	32.0 - 49.1	8.4 - 12.0	2560
Fishmeal (medium grade)	52.6 - 58.8	4.5 - 9.1	2760
Meatmeal	42.0 - 57.2	5.8 - 14.4	3050

Source: Poultry Production and Research Institute, Sind, Karachi.

From the table, the wide variation in nutritive value of each ingredient is evident. Those with a high content of crude fats - the meals and the cakes - often results in oxidative rancidity of both the ingredients and the feed. A peroxide value of above 10 is considered to be unsafe and indicative of the rancidity of the feed.

The climatic conditions of hot and humid countries favour oxidative rancidity, which is of two types:

- hydrolytic rancidity which results from the action of micro organisms on the fat causing simple hydrolysis of the fat into fatty acids, diglycerides, monoglycerides and glycerol. Hydrolytic rancidity does not seem to affect nutritional value.
- lipid peroxidation results in the formation of free radical at the site of unsaturation due to abstraction of hydrogen of the unsaturated fatty acids. It decreases the energy value of the fat. The reaction is catalysed by trace minerals in the presence of oxygen. Vitamin E and other antioxidants like BHT or Endox can block the peroxidation by reconverting it to the original fatty acid. If the peroxides are allowed to form, they continue to break down into a variety of

## Oxidative Rancidity In Poultry Feed



Enlargement of the kidney with as a result of urate accumulation

aldehydes and ketones.

Fat peroxidation impairs some vital metabolic functions by destroying critical nutrients like vitamins A, D and E. This results in problems like loss of reproduction, poor feed conversion, off-flavour poultrymeat and reduced pigmentation of egg and broiler skin as well as diseases like encephalomalacia, exudative diathesis and nutritional myopathy in young chicks. Embryos from the vitamin E-deficient breeders may die at around four days of incubation. Other ailments associated with oxidative rancidity include destruction of epithelium of urinary and respiratory tracts, conjunctivitis, panophthalmitis, stomatitis nephrosis and failure of immune system. Ascites and hydropercardium are common diseases of birds in developing countries often associated with deficiencies of vitamin E and selenium.

### The role of vitamins

Vitamins A, D and E are the so-called “fat-soluble” vitamins. They are rapidly denatured with oxidative rancidity and high pelleting temperatures. Inside the body, vitamin A may be destroyed by bacterial and coccidial infections or by intestinal worms infestation, especially in feeds low in protein and/or fat.

The normal requirements for these vitamins vary with type of birds and their age but also the climatic conditions and stress levels. A guide to the requirements of modern commercial poultry for the fat-soluble vitamins is shown in Tables 2 and 3.

Table 2 Vitamin requirements of broilers

	Starter	Grower	Finisher
Vitamin A (IU/kg)	15,000	10,000	10,000
Vitamin D3 (IU/kg)	3,000	2,000	2,000
Vitamin E (mg/kg)	30	20	20

Table 3 Vitamin requirements of layers

	Starter	Developer	Layer
Vitamin A (IU/kg)	9,000	5,000	5,000
Vitamin D3 (IU/kg)	1,500	1,500	2,000
Vitamin E (mg/kg)	5	4	5.5

### Vitamin A

Vitamin A is required for the normal function and performance of various body tissues/organs including maintenance of mucous membranes, cerebrospinal fluid pressure, growth of cartilage, growth and reproduction, vision and co-ordination.

Commonly available sources of vitamin A include vitamin A alcohol, vitamin A aldehyde and vitamin A acid. Natural sources include fish liver oil and dehydrated alfalfa leaf meal.

The destruction of vitamin A by oxidation rancidity lead to acute deficiency symptoms including retardation of bone growth and suppression of endochondral tissue leading to ataxia. The latter is often confused with calcium deficiency. The other common signs of inadequate vitamin A are watery or milky discharge from the eyes and nostrils, sometimes leading to an accumulation of a ceseated material in the eye, blindness and the complete destruction of the eye ball.

Decreased sperm count and reduced motility is seen in the cockerels while in females, egg production is decreased with blood spots in the eggs and embryonic mortality. Distension of kidneys with urate deposits may be seen in cases of chronic vitamin A deficiency, causing lesions similar to IBD. Lesions or pustules in the pharynx oesophagus are also frequently seen and confused with “wet pox” in unvaccinated birds. In advanced cases, bacterial infection takes place extending to the larynx, which can lead to sudden death by suffocation in apparently healthy birds.

## Oxidative Rancidity In Poultry Feed

### Vitamin D

Vitamin D is important for calcium and phosphorus metabolism and the formation of bone and eggshell. It is a fat-soluble sterol, commonly added to feed as vitamin D3 or calciferol.

Natural sources include fish liver oil. Fat, bile salts and certain other organic acids like lactic acid facilitate vitamin D absorption.

Oxidative rancidity of feed can lead to a serious deficiency of vitamin D and symptoms of severe leg weakness and rickets. The beak and claws become soft and bend easily. The sternum and spinal column may become bent downwards, causing deformity of the thoracic cavity.

### Vitamin E

Oxidative rancidity destroys vitamin E, causing encephalomalacia, poor coordination and transudative diathesis or accumulation of a yellow or a greenish tinged fluid in the subcutaneous tissue including abdominal cavity and pericardial sac, often described as ascites and hydropericardium. Muscular dystrophy may also be observed, as may lowered fertility and hatchability with decreased sperm count. The immune system is also impaired, increasing susceptibility to bacterial and viral infections.

### Preventing oxidative rancidity of the feed

In most developing countries under hot and humid climatic conditions, the problems of oxidative rancidity exacerbate the



Lesions of the oesophagus and buccal cavity caused by vitamin A deficiency and bacterial infection

problem by raising morbidity and mortality and adversely affecting feed conversion, reducing the profitability of the farmer.

The harvesting and storage of feed ingredients has a great effect on the stability of sensitive vitamins and minerals. However, the addition of antioxidants to feed and/or its ingredients can effectively reduce the incidence of oxidative rancidity. Generally, manufacturers of meals and cakes do not add antioxidants on the grounds of cost and prolonged storage under poor conditions often leads to oxidative rancidity of their oil/fat content. Similarly, many vitamin and mineral premixes are imported and stored for a long time and not used separately. Only stabilised vitamins can withstand adverse conditions.

• Improve storage conditions, e.g.

ventilation helps to provide a cool and dry atmosphere.

• Vitamin and mineral premixes should be kept separately and only mixed during feed manufacture.

• Feed should not be stored for more than a week.

• Rotate feed stock so that the older feed is consumed first.

• Use feed antioxidants, e.g. vitamin E, BHT and Endox. The addition of sodium bicarbonate and kaolin (china clay) may help. The inclusion rate of most antioxidants is 200-300g/per ton to meals and cakes having more than 10% crude fats. Similarly these antioxidants can be added to the feed according to the manufacturers instructions. All antioxidants render the feed stable for at least 3-6 weeks even if stored at a high summer temperature of 50°C and a relative humidity of 80-90%.— Dr A A Qureshi, Karachi, Pakistan

Pakistan