Abnormal eggs cause subnormal profits

Finding abnormal eggs is a constant worry for any farm manager. Such eggs hatch poorly when incubated and are rejected in the egg packing or processing plant. Shell-less eggs (leakers) may fall into the litter and break or get dirty. In any case, abnormal eggs mean a loss in profits. What is the cause of abnormal eggs and what can be done to minimise losses?

Broken egg

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The formation of the eggshell is a complex phenomenon and a number of factors including heredity, nutrition, hormones, environment, pathology and management are involved. An egg with optimum shell quality can be formed only when these factors are present in ideal conditions and are functioning in harmony with each other.

The shell of a commercial layer egg contains approx. 2.2 g of calcium in the form of calcium carbonate, 0.3% phosphorus, 0.3% magnesium, traces of sodium, potassium, zinc, manganese, iron and copper. The organic matrix material of the shell has calcium binding properties and its organisation during shell formation influences the strength of the shell.

The hen is genetically capable of placing only a finite amount of calcium in the shell. As the hen ages and the eggs get bigger, a similar amount of calcium has to be spread over a larger surface. Controlling the rate of egg weight can therefore influence eggshell quality as the hen ages.

A high phosphorous content in the feed and excess chlorine may have a negative effect on eggshell quality as they interfere with the acid-base balance (pH) of the blood. Vitamin D is essential for proper calcium and phosphorous utilisation. Abnormalities could be either external (*Table 1*) or internal (*Table 2*).

Causes of shell quality problems

In recent years many researchers have been looking at eggshell quality aspects, the cause of deformation and possible measures to prevent abnormal eggs. The following (*also in Table 3*) provides a brief overview of the most important issues.

Stress and the abnormal eggshell: Translocation of hens from pens to cages resulted in a decrease in egg production and an increase in the proportion of abnormal eggs over the succeeding 18 days. Stressors in poultry flocks such as high cage density, handling and loud noises will result in the release of stress hormones, particularly epinephrine. When released into the blood this hormone is responsible for causing a delay in ovi-position and the cessation of shell gland cuticle formation. Administration of 0.1, 0.25 or 1.0 mg

Table 1 - External abnormality

Abnormality	Cause	Remedy
Loss of pigmentation in the coloured eggs	Infection like IB, EDS, ND, Mycotoxin, chemicals like nicarbazine, monensin, piperazine, inhalation of large quantities of ammonia, high fever, dehydration, inflammation of the mucosa of the uterus, severe stress	Review vaccination programme of IB, EDS, ND and control of ammonia.
Thin, soft and shell-less eggs	Heat stress, IB or EDS infection, severe stress, deficiency of calcium, phosphorus, vitamin D3, eggs laid by obese hen or the young pullet	Control heat stress, review vaccination programme, balanced diet, control over body weight
Body-check eggs	External force or excessive physical exertion when the eggshell is in the process of hardening	Limit the activity of the flock in the afternoon when the shell is hardening
Flat-sided eggs	IB infection, pressure experienced in the uterus while the shell is forming, the loss of co-ordination in the oviduct	Review IB vaccination programme, limit activity in the afternoon etc.
Rough, pimpled egg with calcium deposits	Irritation of the shell secreting glands in the uterus, excess dietary calcium	Optimum management, balanced diet
Misshaped eggs	Abnormal pressure on the egg in the oviduct	Gentle handling of the birds in the afternoon during artificial insemination
Rounded eggs	Genetic	Proper selection in pure lines
Undersized eggs	Bird matured with a very small body size, nutritional deficiency, very high environmental temperature, lack of water, IB infection	Coordinate of body size and light stimulation for maturity
Oversized, double or multi-yolked eggs	Obese hens. Two or more ova reach the full size at approximately the same time and are released at the same time	Optimum bodyweight

Table 2 - Cause and remedy of internal abnormalities in eggs

Abnormality	Cause	Remedy
Watery albumin	Stress, IB infection, high levels of aflatoxin, deficiency of amino acids	IB vaccination, stress control, balanced and mycotoxin free diet
Blood spot in albumin	Rupture of small blood vessels when yolk is released from ovary	Such cases are rare
Meat spot in the egg	Piece of tissue from the oviduct wall	Occurance is very rare
Pale yolk	Anaemia, lack of xanthophylls in ration	Optimum level of xanthophylls in the diet
No internal ring of albumin	IB infection	IB vaccination

of adrenaline (stress hormone) subcutaneously resulted in the retention of eggs currently in the hens' shell glands and in an increased proportion of eggs with abnormal eggshells being laid during the following 10 days. Disturbances when eggs were only lightly calcified tended to result in deformed eggs while those occurring when ovi-position was imminent tended to result in coated eggs. Dusted or pink eggs followed moderate retention, whereas white banded eggs were seen after prolonged retention.

Bicarbonate strengthens eggshell: Bicarbonate in the diet buffers the inherent shell weakening acidosis encountered during the laying process. Shell bicarbonate is generated from carbonic acid via carbonic anhydrase in the eggshell glands. This process releases hydrogen ions into the plasma and increases acidity. Acidosis in the laying process can therefore be considered normal, but as it leads to the formation of inferior shells, remedial action, like the use of bicarbonate, should be taken.

Saline water and eggshell: Intake of saline water depresses the activity of carbonic anhydrase and, in turn, an increase in eggshell defects.

Midnight feeding and eggshell: A study was conducted to determine whether hens would consume feed and improve shell quality when lights and the feeders were allowed to run for 45 minutes at midnight. From this study it was concluded that midnight feeding can improve shell quality. It is necessary to turn the lights on and run the automatic feeders to stimulate the laying hens to consume feed. It has been reported that midnight feeding can be more beneficial for improving the eggshell quality of eggs laid in the morning than for eggs laid in the afternoon.

Lighting and eggshell quality: The incidence of body checked eggs is positively correlated with photoperiod. The incidence of body checked eggs rose from 7.7% to 18.3% when the photoperiod was increased from 16 hours to 19 hours, decreased to 5.8% when photoperiod was returned to16 hours and further decreased to 1% when photoperiod changed to 14 hours.

Chemotherapeutic agents and shell quality: A rapid decline in shell pigmentation is common following the ingestion of certain drugs like sulphonamides and nicarbazine. Drugs like enerofloxacin interfere with shell quality. Tiamulin being bitter in taste decreases water intake and thus also interferes with shell quality. It is advisable to use the antibiotic in split dosage rather than using the full dose in one go. For example, if the calculated dose of an antibiotic is 100 ml, use 50 ml first and then the other 50 ml later. The bitter drugs should always be used with a sweetener.

Chelated minerals: An antagonism exists between mineral elements as some of them share the same site for absorption. It results in poor absorption of the trace minerals causing shell problems. Amino acid complexes (mineral element bonded with the amino acid molecule in 1:1 ratio) reduces the antagonistic interference. The amino acid escorts the metal through the gut wall and into the blood stream. The improvement in the bioavailability of trace minerals therefore improves shell quality. Bioplex (Alltech) has shown promising results.

Tonics: Antimycotoxin preparation containing tricholine acetate, inositol, B12 etc., are commonly used in India. In the author's experience, such prepa-rations damage shell quality as they probably interfere with the blood pH.

Nutrient deficiency: Copper is important in the cross linking of amino acid lysine, which is important for normal membrane and cartilage formation. Copper deficiency results in a defective shell membrane because of reduced cross-linking of collagen and elastin. The subsequent mineralisation over the defective membrane results in wrinkled and deformed eggs.

Heat stress: Panting (hyperventilation) causes an acid-base imbalance in the blood. Bicarbonate ions required for shell formation are produced from CO_2. Panting results in excessive loss of CO_2, which means deficiency of the bicarbonate ultimately leading to poorer shell quality.

Misshapen egg

Wrinkled egg

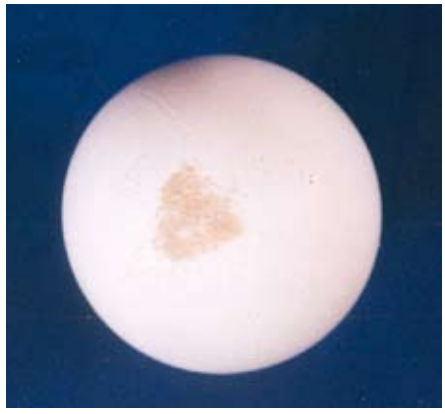
Table 3 - Pathogenic, nutritional and toxic agents that can affect egg quality

Agents	Decreased Egg Size	Shell	Shell Colour	Albumen	Yolk
Infectious agents:					
Infectious bronchitis		Misshapen, wrinkled, thin shells, calcareous deposits	Bleaching of brown Eggs	Watery, loss of demarcation between thick/thin albumen	
Egg Drop Syndrome	+ /-	Shell-less , thin- shelled, rough shelled eggs	Bleaching of brown Eggs	Can be watery	
Newcastle disease	+ /-	May cause thin-shelled eggs, misshapen eggs	Bleaching of brown Eggs	-	
Mycoplasma gallisepticum		Thin shelled			
Avian Influenza		+/-			
Mycotoxins:					
Aflatoxin	+				
T-2	+				
Ochratoxin				Albumen thickness	Decreased size
Nutritional Deficiency:					
Protein	+			Reduced	
Energy	+				
Essential Fatty Acids	+				
Vitamin D	+	Thin-shelled, soft- shelled			
Vitamin E	+				
Vitamin K				Increased blood Spots	
Riboflavin	+				
Calcium / Phosphorus	+	Thin-shelled			
Sodium Chloride	Abrupt				
Potassium	+	Thin-shelled			
Copper	+				
Water	+	Shell-less, wrinkled, misshapen, thin-shelled			
Nutritional Excesses:					
Vitamin D		Localized calcareous deposits			
Magnesium		Thin-shelled			
Zinc	+				
Toxicities:					
Sulfas	+	Thin-shelled	Bleaching of Brown eggs		
Ionophores	+				
Organochloride insecticides		Chalky, thin-shelled	Bleaching of Brown eggs		
Warfarin,Brodifacoum, Diphacinone				Increases blood Spots	
Ammonia (Gas)	+				

Diseases that affect eggshell quality: Infectious bronchitis virus has a preference for the mucus membrane of the reproductive tract. It affects both internal and external quality of the egg. EDS (Egg Drop Syndrome) affects only the shell gland while ND (Newcastle Disease) affects every portion of the reproductive tract. Thus, the infection of these viruses negatively affects shell quality. It is therefore of utmost importance to vaccinate birds against these diseases that have the potential to cause damage to the reproductive tract, mainly IB, ND and EDS.

Vitamin C: This vitamin improves the calcification process and proper structure of the eggshell allowing good respiration and exchange of gases and prevention of infections by micro-organisms. It has a bearing on fertility and hatchability. Deficiency of vitamin C causes increased incidence of thin and broken shell eggs after 40 weeks of age. It also compromises internal egg quality.

Rough shell structure



Weak shell spot

Solutions through nutrition

Once facing the abnormal egg problem there is need for action. The most important element is providing balanced nutrients with special attention to calcium, phosphorous, trace minerals, vitamin D3, protein and linoleic acid. A regular check on the authenticity of the sources of these elements is very important. The calcium source can be 2/3 in grit form and 1/3 in powder form. The ratio of available phosphorus to calcium in the layer diet should be 1:8.

Chelated micro-minerals, like BIOPLEX, should be provided as their bioavailability vis-à-vis inorganic is better. This is of utmost importance for birds after 40

Table 4 - The effect of acidification (KEMGEST) of the gut in broiler breeders on eggshell quality

Parameter	Thin shell %	Broken shell %	Rough shell %
Average of 5 weeks before treatment	3.64	1.18	1.26
Average of 5 weeks after treatment	3.46	0.98	1.10

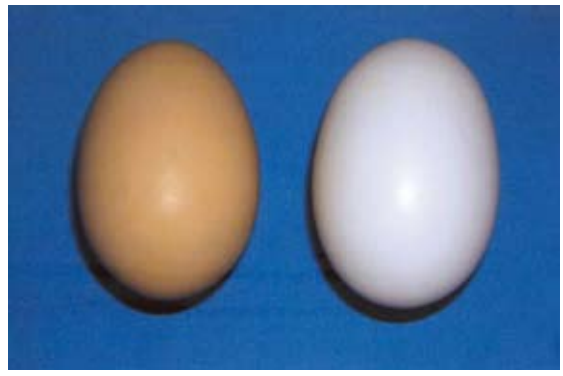
weeks of age. Trials in broiler breeders showed the importance of acidification of the gut. Flocks in which KEMGEST (Kemin) was used at 2.5 kg/tonne of feed showed improvements within a week as the broken, thin and rough-shelled eggs started to decline (*Table 4*). These results prove that gut health is very important for optimum shell quality, which by itself is self-explanatory as all components of the shell are absorbed into the blood through the gut. In this respect one should also be aware of water hardness as excess hardness interferes with the synthesis of the carbonic anhydrase enzyme, which is essential for shell formation.

Awareness of other issues

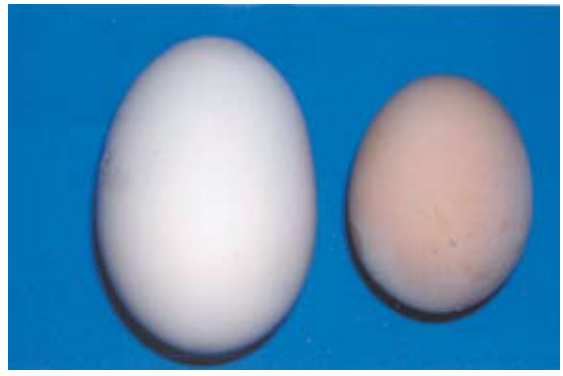
All year round producers have to control shed temperature and air quality along with the fortification of feed in such a way that the birds receive the desired level of all the nutrients essential for shell formation. Quality feed free of mycotoxins is absolutely imperative. During hot weather the additional use of soda-bi-carb may also help to maintain shell quality.

Efforts to maintain egg quality can be counterproductive when using drugs that interfere with the acid-base balance of the blood. Farm managers should also avoid obesity and manage the photo-stimulation of the under-weight pullets to control production of jumbo and small eggs.

Giving attention to nutrients and bird health is not enough, especially not if the housing conditions are being neglected. Providing decent nests or cage floors is a must under all circumstances. The nests and the cage floor should be soft and a slope at just the right angle to let the eggs role away and not crush eggs on the collecting belt. Frequent egg collection and timely repair of malfunctioning systems or damaged cages is a must, just like minimising activity during the early morning and afternoon hours. ■



Difference in colour



Egg size variation