

Salt Intoxication in Commercial Broilers and Breeders – a Clinical and Pathological Description

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ABSTRACT

Several broiler commercial farms were affected with different overdoses of sodium chloride in their feed. Within a period of about one month about six commercial broiler farms and one breeding farm, all from the southern part of Israel were affected. The clinical picture ranged from increased water consumption and wet litter without any mortality to houses with 20% mortality and severe clinical and pathological findings typical of sodium intoxication. The most affected broiler flocks suffered from increased mortality of chicks from 5 days of age with many chicks appearing on their backs paddling and showing difficulty in standing, severe respiratory distress, apathy and some neurological signs suggesting brain involvement such as lack of coordination and opisthotonus. Pathological findings included severe subcutaneous edema, accumulation of clear fluid in the pericardium, ascites and enlarged kidneys. Mortality reached in the most affected flocks was more than 20% within 7 days. The breeding flocks affected by salt overdose did not show any mortality or clinical signs, but suffered from increased water consumption and wet litter and a drop in egg production of up to 8%. Post mortem examination in these flocks revealed enlarged swollen kidneys. Salt or sodium intoxication in poultry is an exceptional situation in the modern poultry industry. In this report we describe the clinical and pathological findings of feed related salt/sodium intoxication at different concentrations and at different ages in broilers and breeders due to technical problems in production at the feed mill.

Keywords: Broilers; Salt intoxication; Poultry Feed; Mortality; Chicks.

INTRODUCTION

Salt or sodium intoxication may occur in any animal species and studies have been carried out to determine the salt toxic levels in chickens, turkeys, ducks and pigeons (1). During the last 50 years the poultry industry has developed from a relatively small and primitive rural farming setup to a state of the art mass production industry with computerized controlled environmental conditions. The advance in poultry farming and production involved vast technological developments of the feed mills, feed production and quality control systems.

Search of the literature reveals that after the 1990's salt

intoxication reports are very rare and deal with crude mistakes in small rural farms such as the case reported in New Zealand by Howell in 1992 (2). Salt intoxication presents the same clinical and pathological findings of other sodium related compounds such as sodium iodide, sodium bicarbonate, and sodium sulfate as reported by Scrivner in 1946 (3). Because these kinds of intoxications are seldom observed in the modern poultry industry, it is important to describe and publish this type of incident.

Israel has a highly developed poultry industry and most of the broiler production is carried out in state of the art

computerized environmental controlled houses. Feed mills in Israel are modern and fully computerized and production of poultry feed is followed by strict quality controlled measures and laboratory analyses. Despite all these technological amenities, a relatively extensive salt/sodium intoxication incident involving several broiler farms with more than one million chicks and two breeding flocks involving about 50,000 birds was observed in 2015 in the southern part of Israel. The clinical picture and economic damage encountered was directly related to the levels of sodium found in the diets as well as the age of the chickens involved.

CASE REPORT

The first suspicion of a possible salt excess appeared in 3 different broiler farms involving chicks from 10 days old to 30 days of age. The main findings were wet litter and an increase in the water intake above the normal. Feed samples sent to the feed mill laboratory showed mildly increased salt levels above the recommended levels of salt (0.2-0.25%).

The episode was first observed when about three days after changing the feed from pre-starter to starter at 10 days of age, a sudden and sharp increase in mortality began in one house in one of the broiler farms, showing large numbers of apparently healthy chicks lying on their backs (Figure 1) and pedaling with their feet. When the position of the birds was manually corrected the chicks showed difficulty in walking, showing spread legs and falling again on their backs. Other chicks showed severe depression and apathy with some clinical signs of brain involvement such as incoordination



Figure 1: Six days old broiler chicks laying on their backs with spread legs due to ascites and anasarca

and head opisthotonus. Many birds within the flock showed severe respiratory distress (Figure 2) similar to that observed in post-vaccinal respiratory reactions or infectious bronchitis.

The bird population in this building was 34,000 birds and the mortality increased from about 40 birds per day to 200 per day reaching a peak of 400 dead chicks per day. Due to a suspicion regarding the feed it was decided to cease feeding and change to a new batch of feed. The clinical signs and mortality however continued for the next 48 hours and then declined gradually reaching normal levels of 1 in 1,000 birds within one week after withdrawal of the suspect feed. The total mortality related to the suspected salt problem in this house reached about 5%.

Feed was sent to the feed mill laboratory and to an independent laboratory (Bar Magen, Israel) for analysis. The results obtained by the feed mill laboratory reported salt levels of 0.4% (based on the chlorine concentration) while the results of the same sample sent to the independent laboratory showed levels of 0.9% of salt based on the sodium content.

The next outbreak of suspected salt poisoning occurred in a kibbutz broiler farm with about 200,000 chicks reared in four different areas each one rearing between 50,000 to 75,000 chicks. In three out of the four rearing areas a sudden increase in mortality was observed in chicks between 6 to 9 days of age. Clinical inspection revealed many chicks on their backs on the floor similar to the signs observed in the previous case. In some houses mortality started to increase from 0.2% per day to 0.5% per day after day five, some houses showed affected chicks with severe clinical signs while other houses at the same rearing farm did not show almost any clinical signs or



Figure 2: Six days old chick gasping showing respiratory distress

increase in mortality. All the houses received different batches of a pre-starter feed from the same feed mill.

Within 24 hours and before suspected feed could be removed from the affected houses a sharp increase in mortality and severity of clinical signs was observed in the youngest birds reaching about 5% mortality per day with thousands of chicks falling on their backs with severe difficulty in breathing. Total mortality in the most affected houses reached 20% and returned to normal within 10 days after withdrawal of the suspected feed.

Feed samples were sent to the feed mill laboratory and levels of 0.8% salt were found according to the same analytical method (chlorine concentration) and equipment. When the same samples were sent to an independent laboratory, the sodium content in the feed samples reached 1.2% (4).

PATHOLOGICAL FINDINGS

In all the affected broiler farms the pathological signs were very similar: dead chicks and chicks laying on their backs showing swollen edematous shanks (Figure 3) and extensive subcutaneous edema (anasarca) (Figure 4). Muscles of affected chicks showed a pale color and their consistency was soft and watery (Figure 5). Affected chicks showed enlarged hearts with a large amount of clear watery fluid in the pericardial sac (Figure 6). Some chicks showed ascites in the abdominal cavity and enlarged pale kidneys without accumulation of urates.



Figure 3: Six days old broiler chicks with swollen edematous shanks

Histopathological examination of muscles, heart, kidneys, and brain did not reveal any abnormal histopathological changes in these organs.

Salt/sodium intoxication in breeding flocks

Two breeding farms were affected: One flock consisted of 24 weeks of age birds which were not laying eggs as yet. The other flock had 45 weeks of age breeders in full egg production.

The 24 weeks old flock showed a sharp increase in water intake from 1:2.2 feed to water ratio to 1:3 feed to water ratio. No mortality or clinical signs were observed in the birds; litter became wet within 48 hours after the last feed batch was fed to the birds. Samples of feed sent to the feed mill laboratory reported levels of 0.3% salt (based on chlorine levels) while the same samples tested by an independent laboratory showed salt levels of 0.6% based on the sodium content (4). At about the same time the 45 weeks of age breeding flock in full production showed a drop in egg production of about 8% in 4 days (Figure 7). The intake of water increased and there was a slight increase in mortality.

Post mortem examination revealed only internal egg laying and enlarged kidneys. Trachea and cloacal swabs were sent to a diagnostic laboratory due a suspected Infectious Bronchitis involvement in the drop of egg production and the enlarged kidneys found in the dead birds. Feed samples were sent for analysis and determination of the levels of protein,

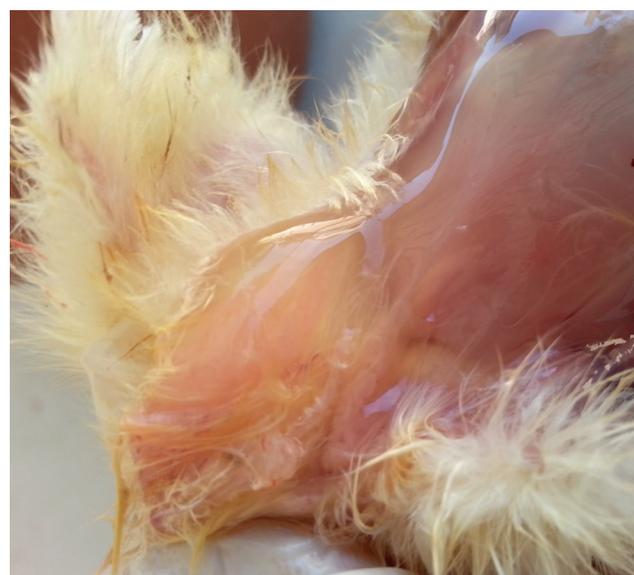


Figure 4: Subcutaneous edema in a six days old broiler chick

Ca, P, and NaCl. The same samples were sent to the feed mill laboratory and to an independent analytical laboratory (Bar-Magen, Israel)

RESULTS

All the trachea and cloacal swabs were negative by PCR and viral isolation to IB, NDV or H9N2 viruses. Feed samples analysis at the feed mill laboratory, revealed different levels of protein, from 14% to 17.5% and levels of salt content ranging from 0.3% to 0.5% (based on the chlorine content) while recommended levels should have been 0.20% to 0.25%. The same feed samples tested by an independent laboratory revealed levels of salt ranging from 0.4% to 0.7% based on the sodium content analysis (4).

Due to the large quantities of feed consumed by the breeding birds the suspected feed was consumed in three days and replaced by a new batch. Egg production started to increase after the feed change and reached original levels within 8 days (Figure 7).

Due to the cases observed in the field and the very different results obtained by the feed mill laboratory and other independent laboratories, an investigation was carried out by the feed mill technical staff in order to find out what was causing the problem of salt/sodium excess. According to the feed mill investigation a mechanical problem in the salt dispensing system caused the excess of salt in some batches

of feed (each batch consisting of about 3 tons). The second problem was that the laboratory at the feed mill calculated the concentration of salt in the feed based on the chlorine content, a test with much lower sensitivity to detect salt levels than the methods used based on sodium content in the feed (4).

DISCUSSION

Salt (NaCl) or sodium intoxication is a very rare event in the modern poultry industry. The high standards of feed production as well as the quality control and analytical methods enable the introduction of feed ingredients including salt and microelements at accurate required levels reducing the frequency of feed intoxications due to excessive levels of ingredients such as microelement, salt or additives such as coccidiostats or antibiotics provided in the feed.

Levels of NaCl in the feed can be determined by two different analytical methods, the first one is based on the determination of the chloride (Cl) levels, while the second method is based on the determination of the sodium (Na) levels (4). Because the ratio of chloride /sodium in salt (NaCl) is 1:1, testing the levels of chloride (Cl) should provide a good extrapolation for the determination of the levels of NaCl in the diet. However, the main problem with this method is that other sources of sodium such as sodium iodide, sodium carbonate or bicarbonate or any other sodium based salt, will not be detected. As demonstrated by Scrivner (3) all sodium based salts can cause sodium intoxication showing very similar clinical and pathological findings.



Figure 5: Pale watery muscles in a six days old broiler chick

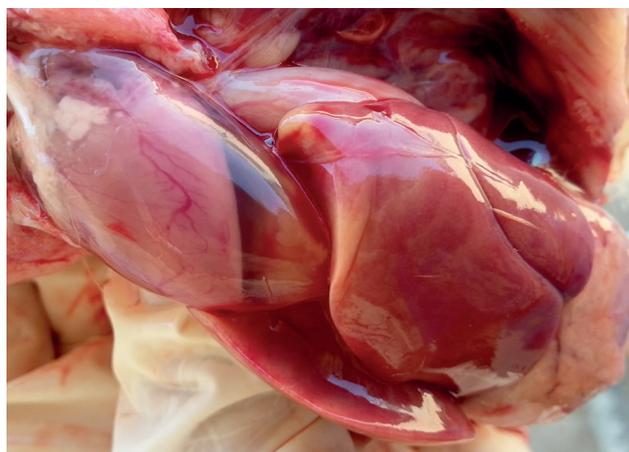


Figure 6: Enlarged heart with pericard filled with clear transudate in a 6 days old broiler chick

In this case the levels of chloride found in the samples did not correlate with the levels of sodium as should be with a NaCl excess only, suggesting the presence of another source of sodium in the feed other than NaCl. While discussing this point with the nutritionists in the feed mill it was found that the feed mill was adding sodium bicarbonate in all diets at levels of 1-2 kg/ton feed, increasing the level of sodium toxicity caused by the excess of NaCl added to the feed due to the technical problem with the salt dispenser.

Because the analytical technique used at the feed mill to calculate the levels of salt (NaCl) was based on the chlorine content only and the sodium was not tested, the feed mill was not aware of the excess of sodium in the diets. The calculated levels of salt in the diets by the feed mill laboratory ranged between 0.4% to 0.9% instead of the recommended levels of 0.20-0.25% salt, thus indicating that salt was added to the feed in overdose. The constant addition of the sodium bicarbonate in the feeds added to the amounts of sodium thus increasing the sodium overdose in the feed.

Many different sodium salts can be involved in sodium intoxication (1, 3). Salt is a critical and an important component of feed for broilers and breeders, (5). The modern commercial production in broilers and breeders require very accurate levels of nutrients and additives, microelements and vitamins as well as antibiotics or anti-coccidial drugs. Lack or excess of some of these ingredients may have very serious effects on the health and production parameters of the flock (5).

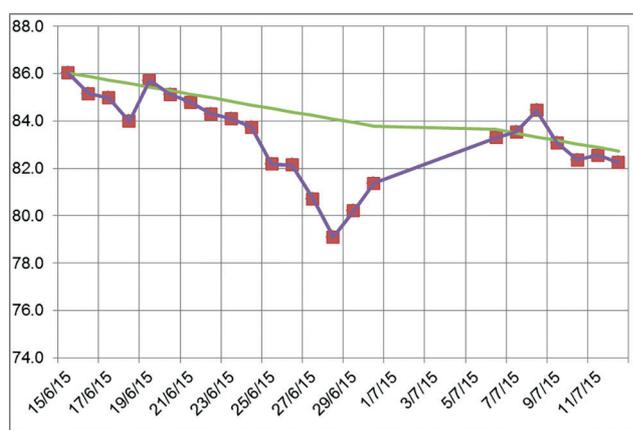


Figure 7: Daily egg production (%) in a 45 weeks breeding flock affected by excess of salt in the feed. A clear recovery of egg production can be seen after feed change.

The severity of the clinical signs and mortality in the broiler farms was closely related to the salt/sodium levels found in the feed as well as the age of the flocks, with younger flocks having a much more acute and severe clinical picture and a higher mortality (up to 20%). As mentioned in this case report birds receiving low overdoses (0.4%) suffered only of increased water intake and wet litter while the broiler flocks receiving the highest concentrations of salt in the feed (0.9-1.2%) suffered from severe clinical and pathological disorders as well as high mortality.

All the clinical and pathological signs observed and the feed analysis results are indicative of an acute salt /sodium intoxication, the severe respiratory signs observed in affected flocks was probably related to lung edema which is a recognized sign of salt intoxication (3).

In a case like this it is important to make a complete differential diagnosis as the clinical signs of incoordination; chicks laying on their back unable to stand, opistotonous and severe respiratory distress could be related to viral infectious diseases such as Infectious Bronchitis or Newcastle. Subcutaneous edema as well as accumulation of fluid in the pericardial sac and ascites could be also related in very young chicks to problems of incubation connected to an excess of humidity during the incubation period producing edematous chicks. In this case different hatcheries were involved and the hatchability rates of the involved flocks were normal.

The rapid reduction in egg production and the enlarged kidneys could be suggestive of a viral infection such as Infectious bronchitis or other viral etiology. The laboratory results as well as the quick recovery in the affected breeding flock after feed change indicates that the drop in egg production and the wet litter was related to the excess of salt in the feed and not to a viral infection.

REFERENCES

1. Peckam, M.C.: Poisons and toxins. In Diseases of Poultry, Biester and Schwarte, 5th Edition. pp. 1212-1252, Iowa State University Press. 1967.
2. Howell, J.: New Zealand Veterinary Journal.40: 36,1992,
3. Scrivner, L.H.: Experimental edema and ascites in poult. JAV-MA.108: 85, 1946.
4. Horowitz, W. and Latimer, G.: Official Methods of Analysis of AOAC, Book by AOAC International, 18th edition, 2010.
5. Harms, R.H.: Effect of removing salt, sodium, or chloride from the diet of commercial layers. Poultry Science. 70: 333-336, 1991.