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Research Application Summary

# Incidence of blood and meat spots in eggs from a commercial poultry farm in Ashanti region of Ghana

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## Abstract

A ninety (90)-day study was carried out in a commercial poultry farm to determine the incidence of blood and meat spots in chicken eggs and to see if temperature variation, egg weight, egg colour and proximity of birds to a noise source is associated with their occurrence. Out of the total of 1040 eggs used in the study, 63.1% of eggs had spots, 31.7% blood spots and 31.4% meat spot. A weak significant association ($X^2 = 0.002$, df = 4, P-value <0.05, Cramer's V value of 0.098) existed between the occurrence of spots (blood and meat spots) and eggshell colour (brown, light brown and incomplete pigmented eggs). No association was observed between the occurrence of spots, layer strains (Novogen Brown and Lohmann Brown), egg weight and temperature variation and the proximity of birds to a noise source (generator).

Keywords: Blood spot, eggs, lohmann, meat spot, noise, novogen, strains

## Résumé

A ninety (90)-day study was carried out in a commercial poultry farm to determine the incidence of blood and meat spots in chicken eggs and to see if temperature variation, egg weight, egg colour and proximity of birds to a noise source is associated with their occurrence. Out of the total of 1040 eggs used in the study, 63.1% of eggs had spots (31.7% blood spot and 31.4% meat spot). A weak significant association ($X^2 = 0.002$, df = 4, P-value <0.05, Cramer's V value of 0.098) existed between the occurrence of spots (blood and meat spots) and eggshell colour (brown, light brown and incomplete pigmented eggs). No association was observed between the occurrence of spots, layer strains (Novogen Brown and Lohmann Brown), egg weight and temperature variation and the proximity of birds to a noise source (generator).

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## Introduction

Good health is essential for national development. Malnutrition, for example, inadequate protein intake, can affect the health of citizens which, ultimately, may retard the rate of economic development. Good nutrition, as part of the observable indicators of good health, is a crucial area that any country which wants to prosper must pay particular attention to. Good nutrition should go hand in hand with economic efficiency. Quality nutrition implies eating balanced diets. The various nutrients present in a balanced diet are carbohydrates, lipids, vitamins, minerals, protein and water. Of great importance is protein since it is vital for sustenance of life processes. However, it is relatively more expensive than the other nutrients and it probably forms greatest limitation for a balanced diet. It is therefore important to ensure the patronage of high-quality protein which is affordable. One of such protein sources with these attributes is the chicken egg. Egg is generally considered as a complete food and is an excellent source of digestible protein, vitamins, minerals, carotenoids and fatty acids that are required for proper nutrition (Song and Kerver, 2000). According to FAO (1985) recommendations, an adult requires 50 g of protein per day, of which 18 g should be of animal origin. Egg consumption differs widely among countries, with per capita consumption being high in the developed countries (Akonor and Akonor, 2014). Aning (2006) stated that per capita consumption of egg in Ghana is low and reported this as 12 eggs per person per year. In Ghana, egg production has seen a steady increase, although not at the same rate as poultry meat; they are utilized as an ingredient in several culinary and industrial applications including baking and production of ice cream and other desserts (Akonor and Akonor, 2014).

It is common knowledge, based on interviews with wholesalers, retailers and consumers, that chicken eggs may, upon breakage, have what is usually described as blood or brown spots in the albumen which may tend to affect their acceptability and/or intake. Many egg consumers have complained about these spots which may even discolour the egg yolk in some instances. Interestingly, some have described these as fertilized eggs with developing embryo hence they discard them.

It has been generally assumed that blood spot or meat spot in eggs are the result of haemorrhaging from small blood vessels of the stigma which are ruptured at the time of ovulation (Shirley, 1965). Campo and Gil (1998) reported that eggs with internal inclusions (blood and meat spots) are not suitable for sale. Eggs with blood and meat spots are usually of low market quality and unattractive to consumers and hatchery men (Amer, 1961). Blood and meat spots may be some of the most earnest obstacles to the marketing of otherwise, high quality eggs. Satjter *et al*. (1952) reported that loss is due not only to eggs candled out during grading but also to possible decreased consumer demand because of the effect on the consumer of blood spots overlooked in grading.

Quite a number of consumers, after observing these blood or meat spots, based on interviews, have stopped buying eggs and this then affects the market share of the retailers. Some consumers have been accusing retailers and wholesalers of giving them eggs with developing embryos and some have suggested that they have been supplied rotten eggs because there was blood or meat spot in them. Bearse *et al*. (1960) indicated that blood spots occurrence in chicken eggs are caused by genetic and environmental factors. For example, Scott *et al*. (1957) showed that low levels of vitamin A increased blood spot incidence in eggs.

For any poultry farm with profit maximization as its main goal, marketing becomes an important economic activity which ultimately determines the profitability of the business. The incidence of blood and meat spots in eggs has been one of the potential threats affecting the marketing of eggs; this, in turn, affects the profitability and sustainability of any commercial poultry layer. The objective of this study was to determine the incidence of blood and meat spots in eggs from a commercial layer farm and the effects of factors such as strain, egg weight, temperature variation and noise on the severity of these spots.

## Materials and methods

**Study area.** The experiment was conducted in a commercial poultry farm called Douglas Farms and Trading Limited (a commercial poultry farm that deals with the production and sale of table eggs), which is situated at Sekyere-Nkwanta, Kubease, in Juabeng Municipality in the Ashanti Region of Ghana. It lies within latitude 1°15N and 1°45N and longitude 6°15W and 7 °W. The Municipality has a bi-modal rainfall pattern. Mean annual temperatures in the Municipality are lowest (around 25°C) in August and highest (about 32°C) in March.

**Background of the Farm and sources of the birds.** The production capacity of the Farm is about 56,000 layers which consists of Lohmann Brown, Novogen Brown, White Leghorn and Hyline strains. The birds are sourced from the following places; Park Agrotech Ghana, Topman Farms and Reiss & Co. In this experiment, Lohmann Brown and Novogen Brown strains were used and the study involved a total of 9000 50-week-old birds.

**Housing systems and management practices at the Farm.** The housing system at the Farm is deep litter system with a total number of 10 buildings and 48 individual pens as at the time of the study. The 10 buildings were constructed in an East-West direction with dwarf-walls and open sides covered with mesh. The average dimension of each pen is 12m x 12m with a stocking density of 1000 birds per pen. Apart from the fencing, disinfection, routine vaccination and some medication programmes practiced, no other biosecurity measure is being undertaken in the Farm. The Farm uses automatic drinkers to provide water to the birds but feed is manually compounded and given to the birds in metal feeders.

**Feeding and medication**. The birds were fed and watered ad libitum. Ingredients used in compounding diets at the Farm were purchased from Aduse-Poku Farms Ltd., Premium Foods Ghana Limited and other reputable outlets in the open market in Kumasi. At the time of study, the formulation used (Table 1) was Diet 1. Medication is a vital pivot in poultry production so therefore the farm provides good array of medication to the birds and sometimes seek veterinary services when the need arises.

**Experimental procedure and data collection**. The experiment was conducted in two phases simultaneously and for 90 (Phase I) and 84 (Phase II) days. The study was conducted at 6-days interval for both phases. Data were collected using random sampling in both phases of the experiment.

**Phase I.** The objective of this phase was to determine the incidence of blood and meat spots in eggs, compare the occurrence in the two different strains, i.e., Lohmann Brown and Novogen Brown birds, and then to determine whether there was a relationship between the weight, colour of the eggs and the incidence of blood and meat spots in eggs. A total of 60 eggs, 30 from each strain were selected randomly daily from egg trays and broken. However, incomplete pigmented eggs were picked as and when seen (convenience sampling). The total number of eggs used for this phase was 900.

**Phase II .** In this phase the objective was to check whether the noise generated by 3.3 kW electrical power output gasoline generator had an influence on the occurrence of blood and meat spots on Novogen Brown birds in a pen labelled (Pen A) which was 1411 (4.7m) away from the gasoline electric generator (3.3 kW) and a pen labelled (Pen D) which is 204ft (68m) away. The study sought to establish the relationship between the weight, colour, effect of noise source and the incidence of blood and meat spots in eggs from Novogen Brown birds. In this instance the eggs were picked at random directly from the two pens. Total eggs collected per day were 10 that is five eggs each from Pen A and Pen D making a total of 140 for 14-day experimental period.

**Table 1. Ingredients and their respective inclusion levels in feed**

| Ingredients | Inclusion level (%) | | |
|---|---|---|---|
| | Diet 1 | Diet 2 | Diet 3 |
| Maize bran | 49.8 | 0 | 0 |
| Maize | 0 | 50 | 45 |
| Wheat bran | 0 | 10 | 10 |
| Soyabean meal | 14.2 | 10 | 15 |
| *Layer concentrate 5% | 14,2 | 10 | 5 |
| Fishmeal | 2.8 | 2 | 5 |
| Oyster shell | 9.5 | 9 | 10 |
| Palm kernel cake | 9.5 | 9 | 10 |
| Total | 100 | 100 | 100 |

*Layer concentrate-5%, Analyzed composition: crude protein, 30%; crude fat, 2%; calcium, 4%; Phosphorus (total), 4.1%; phosphorus (available), 2.1%; Lysine, 2.0%; Methionine, 3%; Methionine + cysteine, 3.5%; Sodium, 2.9%; metabolizable energy, 2280 Kcal/kg. Vitamins per kg of concentrate: Vitamin A, 2000001U; Vitamin D3, 40000IU; Vitamin E, 300mg; Vitamin K3, 40mg; Vitamin B2, 80mg; Vitamin BI2, 0.5mg; Folic acid, 15mg; Niacin, 500mg; Pantothenic acid, 180mg; Choline chloride, 8000mg. Added minerals per kg of concentrate: Mg, 1200mg; Zn, 1000mg; Cu, 120mg; 1, 10mg; Se, 4mg. Enzymes: phytase and Ronozyme NP added.

**Parameters measured**. The parameters measured in the experiment included, the average daily temperature of the pens at 6am, 12pm and 6pm. The weights of all the eggs, their shell colour (light brown, brown and incomplete pigmentation), presence or absence of the blood spot and meat spot were measured and/or determined. Blood spot was determined by the presence of blood on the yolk and/or in the albumen. Meat spot was determined by the presence of brownish tissue in the albumen. Any "degenerated" blood spot was classified as a meat spot. Eggs were categorized by weight into large (>60g), medium (50-60g), small (45-49g) and peewee (<45g) and the average temperatures in pens were categorized as either high (>29°C), moderate (20-29°C) and low (<20°C).

**Statistical Analysis.** All data collected were arranged in Microsoft Excel (2016) and then analyzed by descriptive statistics using Statistical Package for Social Sciences, SPSS (v 20). The results were presented in tables, percentages and chart. A Chi square test was conducted at 5% probability level to determine whether there is an association between variables namely; egg weight, shell colour, temperature in pens, proximity of birds to gasoline generator (3.3 kW) and the occurrence of blood and meat spots and Cramer's V test was used to determine the strength of association where differences were deem significant ($p<0.05$).

## Results and discussion

**Health.** There was an outbreak of Newcastle disease which was detected on thirteenth day of the experiment. Antibact 3x and New Cavac were administered to all the birds and they responded positively to the intervention.

### PHASE I

**Blood and meat spots in eggs from Novogen and Lohmann Brown strains.** Table 2 indicates the occurrence of blood and meat spots in eggs collected from Lohmann and Novogen Brown strains in the phase one of the experiment. From the results, no association ($p>0.05$) occurred between the Novogen Brown and Lohmann Brown strains and the occurrence of blood and meat spots. Blood spot occurrence in both strains was 32% for the 900 eggs collected from both strains

[1]Antibact 3x: Tylosin tartrate, Neomysin sulphate and Oxytetracycline HCI. Dosage: 500g per litre. Manufactured by Maridav, Tema, Ghana.

which was numerically higher than for meat spot (30.3%) occurrence (Table 2). Blood and meat spot occurrence was 62.3% for the 900 eggs collected from both strains. Blood spot occurrence (33.8%) in the Novogen Brown strain was numerically higher than that from eggs collected from Lohmann Brown strain (30.2%) although statistically, blood spot occurrence was not dependent on the strain. Meat spot occurrence was numerically higher in Lohmann brown strain (33.1%) than that in Novogen Brown strain (27.6%) [Table 2]. Numerically, Table 2 indicates that blood and meat spots occurrence was slightly higher in Lohmann Brown strain than that in Novogen Brown strain even though statistically, the occurrence was not dependent on the type of strain.

**Table 2. Incidence of blood and meat spots in Lohmann and Novogen Brown strains**

| Spot | Both strain (n=900) | Strain | | p-valu |
|---|---|---|---|---|
| | | Novogen (n=450) | Lohmann (n--450) | |
| Blood spot | 288 (32.0%) | 152 (33.8%) | 136 (30.2%) | 0.253 |
| Meat spot | 273 (30.3%) | 124 (27.6%) | 149 (33.1%) | 0.070 |
| No spot | 339 (33.7%) | 174 (38.7%) | 165 (37.7%) | 0.536 |
| Blood and meat spots | 561 (62.3%) | 276 (61.3%) | 285 (63.3%) | 0.536 |

The results (Table 2) is different from what was reported by Amer (1961), who showed that there was a significant ($p<0.05$) difference, between breeds (Fayoumi eggs gave the highest percentage of both meat and blood spots, followed by Rhode Island Reds and Leghorns) with respect to eggs containing meat and blood spots.

**Spots occurrence and temperature variation**. It can be observed from Table 3 that the occurrence of blood and meat spot in the two strains was not dependent ($p>0.05$) on temperature variation even though numerically differences occurred in blood and meat spot occurrence as the temperature varied. Blood and meat spots occurrence were numerically higher at temperature range from 20-29°C than temperatures above 29°C. This result corroborates to what was reported by Wilson *et al*. (1964) when they found out that fewer blood spots were produced in eggs by Leghorn hens at 32°C than in a variable temperature of 7.9 to 23.1°C or a constant temperature of 21°C. The variable temperature of 7.9°C to 23.1°C produced more eggs with blood spots than the 21°C temperature. This may have been due to difference in blood spots occurrences to the temperature changes leading to either an increase in blood pressure or an increase in ovarian capillary fragility.

**Table 3. Temperature variations and occurrence of spots in both strains**

| Spots at high temperature (>29) | Strain | | | p-value | Spots at moderate temperature (20-29 °C) | Strain | | | p-value |
|---|---|---|---|---|---|---|---|---|---|
| | Both strains (n=480) | Novogen (n=210) | Lohmann (n=270) | | | Both strains (n=360) | Novogen (n=210) | Lohmann (n=150) | |
| Blood spot | 144 (30%) | 64 (30.5%) | 80 (29.6%) | 0.160 | Blood spot | 131 (36.4%) | 80 (38.1%) | 51 (36.4%) | 0.647 |
| Meat spot | 151 (31.5%) | 57 (27.1%) | 94 (34.8%) | | Meat spot | 99 (27.5%) | 58 (27.6%) | 41 (27.3%) | |
| No spot | 185 (38.5) | 89 (42.4%) | 96 (35.6) | | No spot | 130 (36.1%) | 72 (34.8%) | 58 (38.7%) | |
| Blood and meat spot | 291 (61.5%) | 141 (67.6%) | 174 (64.4%) | 0.076 | Blood and meat spot | 230 (63.9%) | 138 (65.7%) | 92 (61.3%) | 0.229 |

[2]New Cavac: each 0.5 ml contains > 50 PD 50 units of the inactivated Newcastle Disease virus clone 30. Manufactured by MSD Health. South Africa

**PHASE II**

**Proximity of birds to generator and spots occurrence**. Table 4 shows the occurrence of blood and meat spots in eggs from the Novogen Brown strain and the proximity of birds to generator. It was realized that no association (X2= 0.537, df = 2, p-value <0.05) occurred between the incidence of spots (blood and meat) and the proximity of birds to a noise (generator) source. The frequency of blood spot in pen A was 25.7% while that of pen D was 34.30%. Meat spot occurrence was numerically higher (41.4%) in pen A than in pen D (35.7%). The numerical difference could be due to chance and the fact that birds in pen A may have adapted to the effect of the noise from the 3.3 kW electrical power gasoline generator.

**Table 4. Proximity of birds to generator (noise) on the incidence of spots in the Novogen strain**

| Spot | Pen* | | p-value |
|---|---|---|---|
| | Pen A (n=70) | Pen D (n=70) | |
| Blood spot | 18 (25.7%) | 24 (34.3%) | |
| Meat spot | 29 (41.4%) | 25 (35.7%) | |
| No spot | 23 (32.9%) | 21 (30.0%) | 0.537 |
| Blood and meat spot | 47 (67.1%) | 49 (70%) | |

*Pens A and D were 4.7m and 68m respectively from the noise (generator) source

**Both PHASE I and PHASE II**. Table 5 and Figure 1 shows the occurrence of blood and meat spots, in numbers and percentages, respectively, in eggs collected from the commercial poultry Farm irrespective of the strain, colour of eggshell, egg weight and proximity of birds to a noise source.

**Table 5. Blood and meat spots occurrence in eggs from the commercial poultry farm**

| Total number of eggs | Blood spot | Meat spot | Normal |
|---|---|---|---|
| 1040 | 330 | 327 | 383 |

Blood and meat spots in eggs. It can be observed (Table 5 and Figure 1) that, out of 1040 eggs collected from the Farm from both Lohmann and Novogen Brown strains, 330 (31.7%) eggs had blood spots while 327 (31.4%) had meat spots. A total of 383 eggs were classified as normal. The total of 657 eggs with either blood or meat spots represents 63.2% of all the eggs (1040) examined. Satjter *et al*. (1952) indicated that blood spots in chicken eggs represent a serious loss to the poultry industry. The results obtained in this study (Table 5 and Figure 1) are numerically higher than what was documented by the United States Department of Agriculture (USDA, 1987) that blood and meat spots occurrence in brown eggs was 18% (2.5% blood spots and 15.5% meat spots), whereas the frequency in white eggs was only 0.5% per group.

Egg weight and spots (blood and meat). Table 6 shows the occurrence of blood and meat spots in eggs from egg with differing weights. It can be seen (Table 6) that no association (X2 = 0.505, df= 6, P>0.05) existed between the occurrence of blood and meat spots and the weight of eggs although, numerically, a high figure, i.e., 58 (36.0%) blood spots was found in eggs weighing less than 45g (Pee Wee) followed by small sized egg (32.2%), large sized egg (31.1%) and then medium sized eggs (27.1%). Meat spots occurrence in eggs was numerically higher (35.0%) in large sized eggs, followed by smaller sized eggs (31.2%), medium sized eggs (30.5%) and then pee wee (29.2%). It was realised that medium sized eggs had greater proportion (42.4%) of normal eggs followed by smaller sized eggs (36.6%), Pee wee (34.8%) and then eggs with size greater than 60g (33.9%).

The smaller proportion of the eggs classified as normal in large eggs could be that in the course of formation of large egg, there could be a greater pressure and friction between the walls of the oviduct, more than in the other egg grades (medium, small and pee wee), and the developing egg as it moves down the reproductive system. This may lead to a greater chance of pieces of tissues and glands in the oviduct detaching. These tissues may end up forming part of the egg and eventually causing lager sized eggs (>60 g) to have more blood and meat spots combined (66.1%) in them than in the other egg grades {medium (57.6%), small (63.4%) and pee wee (65.2%)}.

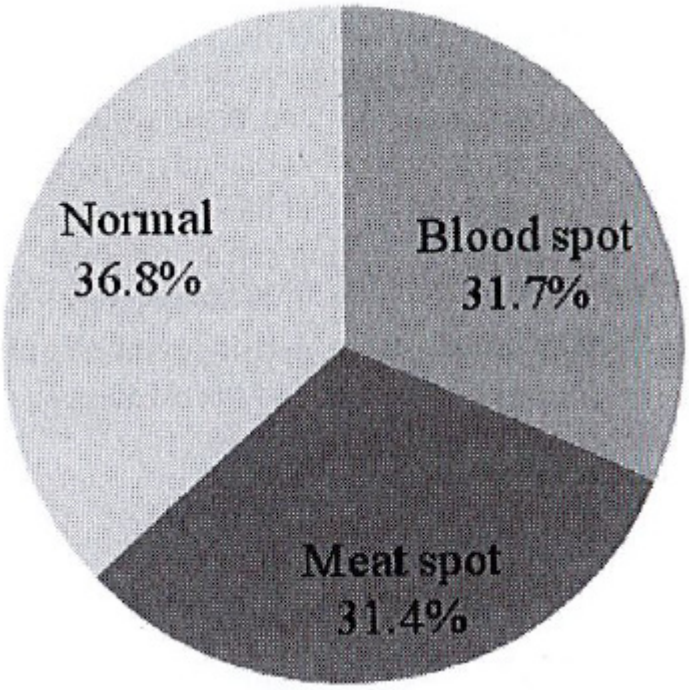


**Figure 1. Blood and meat spots incidence**

**Table 6. Spots occurrence in a commercial poultry farm and how they relate to weight of eggs**

| Egg grade | Spot/Normal egg | | | p-value |
|---|---|---|---|---|
| | Blood spot | Meat spot | Normal egg | |
| Large (n=180) | 56 (31.1%) | 63 (35.0%) | 61 (33.9%) | |
| Medium (n=177) | 48 (27.1%) | 54 (30.5%) | 75 (42.4%) | |
| Small (n=522) | 168 (32.2%) | 163 (31.2%) | 191 (36.6%) | 0.505 |
| Pee Wee (n=161) | 58 (36.0%) | 47 (29.2%) | 56 (34.8%) | |

**Eggshell colour and spots (blood and meat) in eggs.** Table 7 shows the occurrence of blood and meat spots in eggs from the Farm of three differing colours. A weak significant association (X2 = 0.002, df = 4, P-value <0.05, Cramer's V value of 0.098) occurred between eggshell colour and the incidence of blood and meat spots in eggs examined. The results (Table 7) is comparable to that reported by Sekeroglu *et al*. (2016) where the number of blood and meat spots in eggs increased as the shell colour darkened. However, the incidence of blood and meat spots were not significantly different in the three different colour variations even though a numerical difference occurred in the different colours. Blood spot occurrence was numerically higher in brown eggshell coloured and incomplete pigmented eggs than meat spot incidence but it was the opposite in the light brown eggshell coloured eggs. Normal eggs were statistically more in brown and light brown eggshell coloured eggs but not for incomplete pigmented eggs.

**Table 7. Egg colour and the incidence of spots in the commercial poultry farm**

| Egg color | Spot/Normal egg | | | p-value |
|---|---|---|---|---|
| | Blood spot | Meat spot | Normal egg | |
| Light brown (n=229) | 56a (24.5%) | 60a (26.2%) | 113b (49.3%) | |
| Brown (n=721) | 242a (33.6%) | 238a (33.0%) | 241b (33.4%) | 0.000 |
| Incomplete (n=90) | 32a (35.6%) | 29a (32.2%) | 29a (32.2%) | |

[a b] Means on the same row with different superscript are statistically different at $p<0.05$

The results obtained (Table 7) is similar to what was reported by Campo and Gil (1998) where they stated that there is apparent positive correlation between darkness of shell and meat spot occurrence. Even though no significant difference occurred between normal eggs and blood and meat spots in incomplete pigmented egg, it can be seen that the normal eggs occurrence in light brown and brown eggshell coloured eggs were higher than incomplete pigmented eggs. The incomplete pigmentation may be because of insufficient energy available for the bird to complete the pigmentation process in the uterus which may arise as a result of birds being stressed. Birds pump a lot of energy into maintenance of constant internal environment than the production activities like pigmentation of eggshell.

## Conclusion

The occurrence of spots (blood and meat spots) in eggs from the commercial poultry farm was high (63.2%); blood spot alone was (31.7%) whilst meat spot occurrence was (31.4%). Blood and meat spots occurrence did not seem to be dependent on the strain of bird, noise, temperature variation and egg weight. A weak significant association ($X2 = 0.002$, $df = 4$, P-value $<0.05$, Cramer's V value of 0.098) occurred between spots (blood and meat spots) occurrence and eggshell colour (Dark brown, light brown and incomplete pigmented egg).

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