Arab Gulf J. Scient. Res., **15** (1), pp. 91-98 (1997)

The Effects of Pre-Slaughter Withholding of Feed and Water on Carcass Yield and Meat Quality of Broiler Chickens

Joseph, J.K.,* Awosanya, B. and Adebua, B.A.

Department of Animal Production, Faculty of Agriculture, University of Ilorin, Ilorin, Nigeria

ABSTRACT. Ninety broiler chickens with an average weight of 1.4kg were allocated at random to one of ten treatments to assess the effects of withholding feed alone or feed together with water on carcass shrinkage and meat quality. The ten treatments were: slaughter from the feed lot (control duplicated), and sampling times of 12, 24, 36 and 48h. Live and carcass weights were taken to monitor shrinkage along with relevant meat quality parameters.

Live and carcass weights, weights of head, liver, kidneys and heart decreased progressively as the length of fasting period increased. The progressive decreases in weights were found to be more pronounced in animals from which feed together with waters were withdrawn. After 24 hours of fasting, decrease in weights were found to be significant ($P < 0.05$).

Ultimate pH and index of water holding capacity of the meats also decreased with the increase in length of fasting period with a concomitant decrease in cooking losses. The fat content of the carcass component decreased with increase in length of fasting. The implications of the effect of these observations on commercial broiler chickens meat production in the tropics are discussed.

*All future correspondence.

The poultry processor is not only interested in the general quality of his product but also in saleable weight, which can be affected by many factors such as moisture content. The consumer is mainly concerned with the palatability and yield of the cooked bird, both of which may be dependent upon various factors such as water content of the tissues (Froning *et al.* 1960).

It is common practice among producers and meat processors to fast animals prior to sale or slaughter to reduce production costs (producers) and to reduce the fecal contamination of the meat (processors). These periods of fasting, in most cases, arbitrarily range between 12 - 48h.

Varying periods of fasting have been found to decrease live and eviscerated weights (May and Brunson 1955, Smidt *et al.* 1964, Wabeck 1972), yield of saleable products (Veerkamp 1978, Lyon *et al.* 1991), shear value of meat (Lyon *et al.* 1991), lower fecal contents along digestive track thereby lessening the possibility of fecal contamination (Wabeck 1972, May *et al.* 1988, Papa 1990), increase shear strengths and decrease moisture contents of the various gastrointestinal tract segments examined (Bilgiri 1988) and improve effectiveness of the rigor mortis acceleration techniques (such as electrical stimulation and high temperature conditioning) (Sams and Mills 1993) of broiler chickens. While fasting has been indicated to influence meat quality parameters such as meat colour, the effects have been assumed to be quite small and generally believed to have little commercial importance.

The purpose of the present study is therefore to determine the effects of withholding of feed alone or feed and water over a 48 hours period prior to slaughter on carcass yield and meat quality of broiler chickens.

Materials and Methods

Carcass Evaluation

Ninety male broiler chickens (eight weeks old) were used in this study. They were raised under uniform conditions of feeding and management to and average market weight of 1.4 kg to minimize initial differences in carcass composition. One week before slaughter commenced, all birds were weighed and allocated to ten treatments T_1 – withdrawal from the feedlot followed by slaughter (duplicated), T_2 – T_5 consisted of 12, 24, 36 and 48 hours periods without feed alone but with water while T_6 – T_9 consisted of treatments for the same period but without feed and water prior to slaughter.

The birds were slaughtered by severing the carotid artery and the jugular veins.

Prior to slaughtering, live weight of each bird was taken. Each bird was scalded after dipping in hot water (about 60°C) for a minute and all feathers removed manually. After weighing, the defeathered bird was dissected and all internal organs and abdominal fat were carefully removed after which the carcass was weighed to obtain eviscerated weight and dressing percentage computed as a ratio of live weight (Joseph *et al.* 1992). The weight of head, gizzard, liver, kidney and heart were taken. Each eviscerated carcass was split into two equal longitudinal halves. One half of the carcass was weighed and carefully dissected into skin, fat, bone and lean meat. The lean meat, fat and bones were then weighed separately and percentage lean meat, fat and bone calculated as a ratio of carcass weight. Visual assessment of colour and wetness of the lean meat were made as described by MacDougall and Disney (1967).

Analytical procedures

The pH readings were taken post-mortem after 45 minutes (pH_1), 2 hours (pH_2) and after overnight storage (pH ultimate) by sticking the electrodes of a standardised Kent EIL 7020 pH meter into the thigh muscles. Dry matter, fat, crude protein and ash contents were determined as described by A.O.A.C. (1980). Water holding capacity of the muscles were assessed using the filter press method as described by MacDougall and Disney (1967). Cooking losses were determined by comparing weight of meat before and after 30 minutes cooking (Wood *et al.* 1981).

Nine birds were sampled per treatment for each of the ten experimental treatments with the control experiment duplicated. Statistical analysis of variance was based on 2 x 5 factorial design of two types of fasting (withdrawal of feed alone or feed and water) and five length of fasting periods (0, 12, 24, 36 or 48 hours). Least significant difference between sample means were determined by Duncan's multiple range test (Duncan 1955).

Results

Live and carcass weights, weights of head, liver, kidney and heart of the broilers decreased progressively as the length of fasting period increased (Table 1). The dressing out percentage also decreased. After 24 hours of fasting the decreases in weights determined became significant ($P < 0.05$). Percentage dry matter, ash and crude protein of the meat of the experimental birds, increased as the length of fasting period increased (Table 1). As the fasting periods increased, significant increases ($P < 0.05$) in ultimate pH and water holding capacity were observed. However, a reverse order was observed with crude fat and cooking losses as fasting periods increased (Table 1). Variation in tested parameters was found to be significant ($P < 0.05$) after 24 hours of fasting.

Table 1. The Effects of Withdrawal of Feed Alone or Feed and Water and Duration of Fasting on Carcass Characteristics of Broiler Chickens

Parameters	Withdrawal of :									
	Feed alone					Feed and water				
	Duration of Withdrawal (hrs)									
	0(Control)	12	24	36	48	0(Control)	12	24	36	48
Live weight (g)	1441.8^{a}	1430.1^{ab}	1410.4^{bc}	1398.2^{c}	1370.9^{d}	1445.3^{a}	1432.0^{ab}	1423.0^{b}	1381.1^{d}	1354.3^{e}
Carcass weight (g)	1004.9^{a}	973.9^{b}	930.9^{b}	892.1^{c}	854.1^{d}	1000.2^{a}	956.6^{b}	898.9^{c}	894.4^{d}	819.4^{e}
Dressing out percentage	67.7^{a}	68.1^{a}	66.0^{ab}	63.8^{b}	61.3^{c}	69.2^{a}	66.8^{a}	64.1^{b}	61.5^{bc}	60.5^{c}
Head weight (g)	41.8^{a}	41.5^{ab}	40.0^{ab}	39.3^{b}	39.0^{b}	42.0a	41.8^{a}	39.2^{b}	38.8^{b}	38.4^{b}
Live weight (g)	28.8^{a}	28.2^{a}	26.0^{b}	25.7^{b}	25.0^{b}	28.7^{a}	28.1^{a}	25.9^{b}	25.1^{b}	24.6^{b}
Kidneys weight (g)	7.9^{a}	7.9^{a}	7.4^{b}	7.2^{bc}	7.0^{bc}	8.1^{a}	8.0^{a}	7.6^{ab}	7.1^{bc}	6.9^{c}
Heart weight (g)	9.4^{a}	9.2^{ab}	9.0^{ab}	8.9^{b}	8.8^{b}	9.3^{ab}	9.1^{ab}	8.8^{b}	8.8^{b}	8.7^{b}
Gizzard weight (g)	75.1^{a}	74.8^{a}	73.9^{a}	73.7^{a}	73.7^{a}	75.3^{a}	74.5^{a}	73.6^{a}	73.4^{a}	73.4^{a}
Lean meat (%)**	64.5^{a}	64.0^{a}	63.8^{ab}	62.4^{ab}	61.0^{b}	64.2^{a}	63.9^{a}	63.0^{ab}	62.1^{ab}	60.8^{b}
Bone (%)**	30.9^{a}	31.7^{ab}	32.3^{ab}	34.1^{ab}	35.8^{b}	30.9^{a}	31.9^{ab}	33.3^{ab}	34.6^{ab}	36.3^{b}
Fat (%)**	4.0^{ab}	3.9^{ab}	3.6^{c}	3.0^{d}	2.9^{d}	4.1^{a}	3.8^{b}	3.4^{c}	2.8^{de}	2.6^{e}
Meat colour scores*	5.0^{a}	5.9^{b}	6.4^{c}	6.5^{c}	6.5^{c}	5.0^{a}	6.0^{bc}	6.4^{c}	6.5^{c}	6.5^{c}
Meat wetness scores*	3.5^{a}	4.0^{b}	4.5^{c}	4.9^{c}	5.4^{d}	3.5^{a}	4.1^{bc}	4.7^{c}	5.2^{d}	5.5^{d}
Dry matter (%)	27.4^{a}	28.6^{ab}	30.7^{ab}	31.3^{ab}	33.2^{b}	27.5^{a}	29.2^{ab}	32.4^{ab}	33.6^{b}	35.6^{b}
Crude protein (% dry wt.)	63.7^{a}	64.9^{ab}	67.1^{ab}	67.8^{ab}	68.3^{ab}	63.8^{a}	66.6^{ab}	68.6^{ab}	69.3^{b}	69.4^{b}
Crude fat (% dry wt.)	30.9^{a}	29.8^{ab}	27.5^{ab}	26.8^{ab}	26.0^{b}	30.8^{a}	28.1^{ab}	26.0^{b}	25.1^{b}	24.7^{b}
Ash (% dry wt.)	3.7^{a}	3.7^{a}	3.8^{a}	3.9^{ab}	4.1^{b}	3.7^{a}	3.7^{a}	3.9^{ab}	4.1^{b}	4.4^{c}
Ultimate pH	5.61^{a}	5.72^{ab}	5.94^{ab}	6.05^{b}	6.14^{bc}	5.60^{a}	5.93^{ab}	6.22^{bc}	6.33^{bc}	6.53^{c}
Index of water holding capacity	51.0^{a}	52.1^{ab}	52.2^{ab}	52.3^{ab}	53.1^{b}	50.8^{a}	53.0^{b}	54.2^{bc}	54.8^{c}	55.7^{c}
Cooking losses (%)	38.2^{a}	36.1^{ab}	34.1^{b}	33.6^{bc}	32.4^{b}	38.0^{a}	35.7^{a}	33.2^{bc}	31.8^{c}	30.0^{c}

* Rated on a scale of 7 = deep colour, or dry; 1 = pale, or wet.

** All percentages were computed as a ratio of carcass weight.

Different subscripts on means within a row indicates significant difference ($P < 0.05$).

Length of time of fasting was found to influence meat colour and wetness, with birds without feed or feed and water for 24 hours preslaughter having darker and drier meat (Table 1). Carcass component proportions changed as the length of time without feed or feed and water preslaughter increased. Percentage fat and lean meat decreased significantly ($P < 0.05$) as length of fasting increased. Regardless of which was withdrawn, feed or feed and water, percentage bone progressively increased ($P < 0.05$) as the fasting period increased.

Discussion

The observed decrease in the live and carcass weights and weights of the organs could be attributed to the removal of feed and faeces from the intestine of the birds and carcass shrinkage due to dehydration. The decrease could also be attributed to the fact that in the absence of feed or feed and water the bird's body may be forced to switch to wasting metabolism, drawing on its stored reserved of carbohydrates and fat and within a day or so, on its protein tissues as well, in order to meet the maintainance metabolic energy requirement (Whitney and Hamilton 1981).

The percentage dry matter, crude protein and ash content of the meat which appeared to be on the increase as the period of fasting increased could be attributed to carcass shrinkage and dehydration with a concomitant decrease in moisture and fat content, which led to the change in body component ratio. The increase in ultimate pH as the period of fasting increased could be due to a decrease in glycogen content of the muscle leading to a lower lactic acid production post slaughter, and hence a higher ultimate pH of muscles.

The increase in ultimate pH of the meat may be linked with the decrease in percentage cooking losses of the meat because it is not easy to express juice from meat with high pH (Lawrie 1985).

The result of the sensory scores for muscle colour and wetness may be associated with shrinkage of the muscle and the lower preslaughter glycogen reserves as the fasting period increased which may have led to a higher ultimate pH and consequently darker meat (Lawrie 1985). The decrease in the fat content component of the carcass is in line with the earlier explanation that in order for the body cells to continue to function during fasting it will draw on its stored reserves of fat when the stored glycogen is depleted or almost depleted (Lawrie 1985, Whitney and Hamilton 1981).

Conclusion

In conclusion, it appears that the usual practice in the poultry industry to withdraw feed and water from market age broilers several hours (arbitrarily taken) prior to processing is not a good practice. This is because from our study with broiler chickens the effect of fasting the animals on all the parameters studied became pronounced ($P < 0.05$) after 24 hours of fasting period. We therefore suggest that broiler chickens for commercial meat supply should be slaughtered after a short period of fasting between 0 and 12 hr. for good quality meat production. It is recommended that the effect of fasting periods between 0 and 12 hr. be investigated in future studies.

References

A.O.A.C. (1980) Official methods of analysis. Association of Official Analytical Chemists, Washington, D.C.

Bilgiri, S.F. (1988) Research note: Effect of Feed and water withdrawal on shear strength of broiler gastrointestinal tract. *Poultry Sci.* **67:** 445-847.

Duncan, D.B. (1955) Multiple range and multiple F test. *Biometrics* **11:** 1-42.

Froning, G.W., Swanson, M.H. and **Benson, H.N.** (1960) Moisture levels in frozen poultry as related to thawing losses, cooking losses, and palatability. *Poultry Sci.* **39:** 373-377.

Joseph, J.K., Balogun, O.O. and **Famuyiwa, M.A.** (1992) Carcass evaluation and organoleptic assessment of quality attributes of some selected Nigerian birds. *Bull. Anim. Prod. Afric.* **40:** 97-102.

Lawrie, R.A. (1985) *Meat Science.* Pergamon Press, New York.

Lyon, C.E., Papa, C.M. and **Wilson, Jr. R.L.** (1991) Effect of feed withdrawal on yields, muscle pH, and texture of broiler breast meat. *Poultry Sci.* **70:** 1020-1025.

MacDougall, D.B. and **Disney, J.G.** (1967) Quality characteristics of pork with special reference to Pietrain X landrace and landrace pigs at different weights. *J. Food Tech.* **2:** 285-297.

May, K.N. and **Brunson, C.C.** (1955) Effect of starvation period on eviscerated yield of broiler. *Poultry Sci.* **34:** 1210.

May, J.D., Branton, S.L., Deaton, J.W. and **Simmons, J.D.** (1988) Effect of environmental temperature and feeding regimen on quantity of digestive tract contents of broilers. *Poultry Sci.* **67:** 64-71.

Papa, C.M. (1990) Lower gut contents of broiler chickens withdrawn from feed and held in cages. *Poultry Sci.* **70:** 375-380.

Sams, A.R. and **Mills, K.A.** (1993) The effect of Feed withdrawal duration on the responsiveness of broiler pectoralis to rigor mortis acceleration. *Poultry Sci.* **72:** 1789-1796.

Smidt, M.J., Formica, S.D. and **Fritz, J.C.** (1964) Effect of fasting prior to slaughter on yield of broilers. *Poultry Sci.* **43:** 931-934.

Veerkamp, C.H. (1978) The influence of fasting and transport on yields of broilers. *Poultry Sci.* **57:** 634-638.

Wabeck, C.J. (1972) Feed and water withdrawal time relationship to processing yield and potential fecal contamination of broilers. *Poultry Sci.* **51:** 1119-1121.

Whitney, E.N. and **Hamilton, E.M.** (1981) *Understanding Nutrition.* West Publ. Co., New York.

Wood, J.D., Mottram, D.S. and **Brown, A.J.** (1981) A note on the eating quality of pork from lean pigs. *Ani. Prod.* **32:** 117-120.

(Received 22/01/1994;
in revised form 97/06/1995)

تأثير الاحتفاظ بالغذاء والماء قبل الذبح على إنتاجية ونوعية (جودة) لحوم الدجاج اللاحم (فروج اللحم)

جوزيف ، جي .ك و اوسانيا ،بي و اديبا ،بي .ايه

قسم الإنتاج الحيواني - كلية الزراعة - جامعة ايلورين - ايلورين - نيجيريا

تم اختيار عينات عشوائية قوام كل منها تسعون دجاجة لاحمة ، متوسط وزن الدجاجة ٤ ,١ كجم وأخضعت كل عينة لمعاملة من عشر معاملات بغرض تقييم تأثير الاحتفاظ بالغذاء فقط أو الغذاء والماء معاً على معدلات إنكماش اللحوم ونوعيتها . وشملت المعاملات العشر : الذبح عند التغذية (معاملة المقارنة مكرره) بالاضافة إلى عينات تذبح بعد ١٢ ساعة ، ٢٤ ساعة ، ٣٦ ساعة و ٤٨ ساعة بعد التغذية . ورصدت أوزان الدجاج الحي ولحوم الذبيح بغرض تقدير الانكماش وأي معايير جودة ذات صلة .

وقد أظهرت النتائج إنخفاضاً منتظماً في أوزان الرأس والكبد والكلا والقلب مع امتداد فترة الصيام . وانخفضت الأوزان بمعدلات أكبر في الدجاج الذي سحب منه الغذاء والماء معاً . وكان الانخفاض في الوزن معنوياً بعد ٢٤ ساعة من الصيام (مستوى المعنوية أقل من ٠٥ ,٠) .

كذلك انخفضت أقصى معدلات الرقم الهيدروجيني (pH) ومؤشر مدى ارتباط الماء باللحوم مع الزيادة في طول فترة الصيام . وصاحب ذلك إنخفاض في نسبة الفقد أثناء الطبخ . كما أنخفض المحتوى الدهني في اللحوم مع ازدياد طول مدة الصيام . ويتطرق البحث بالمناقشة إلى تأثير هذه الملاحظات على الانتاج التجاري للدجاج اللاحم في المناطق الحارة (المدارية) .