ntemortem Stress and Chicken Broiler Meat Quality.

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SUMMARY: Effects of ante-mortem stress, chemically generated by subcutaneous injections of epinephrine, on post-mortem broiler muscle ysiology and subsequent meat quality were studied. Also the effects of long and short term natural stress on meat quality characteristics have en evaluated.

Blood lactate and glucose levels have been measured as well as tissue lactate, glycogen and glucose at time of slaughter and 24 hours post-rtem. The color (e.g. L* and a* values) of the raw meat has been estimated.

Injections of epinephrine resulted in higher terminal muscle pH in birds killed 4 to 16 hours post injection. Also these birds showed nificantly darker breast meat (lower L* values).

sults of the long and short term stress experiment indicated only some minor effects on meat quality characteristics.

INTRODUCTION: Variation in poultry meat quality is partly affected by processes like stunning, scalding and picking, duration of the ocess, way of cutting up of the birds, etc. An important part of poultry meat quality however is already determined at the moment of stunning d killing.

The negative effects of ante mortem stress on poultry meat quality are neither well documented, nor understood or consistent.

Simpson and Goodwin (1975), Lee *et al.* (1976) and Froning *et al.* (1978) found some negative effects on meat quality caused by heat ess. Also pre slaughter free struggle has shown to affect meat quality negatively (Kahn en Nakamura (1970), Ma *et al.* (1971), Grey *et al.* 974), Froning *et al.* (1978) and Ngoka *et al.* (1982).

Froning *et al.*, (1978), Ngoka *et al.*, (1982) and Ngoka and Froning, (1982) showed an effect of stress caused by heat, free struggle and citement on the occurrence of darker turkey meat color.

Woods and Richards (1975) found an increased toughness in broiler breast meat caused by pre slaughter heat stress and free struggle. This creased toughness was due to the increased glycolytic rate and subsequent depletion of glycogen in the muscles.

Kahn and Nakamura (1970) concluded that minimizing postmortem glycolysis by epinephrine injection 5 hours prior to slaughter resulted h a higher ultimate muscle pH and the most tender meat. Woods and Richards (1975) found that epinephrine injections resulted in increased uscle toughness.

The work attempting to relate antemortem stress to poultry meat quality is often contradictory and incomplete. Much of the contradiction ey be due to variation in actual physiological stress generated in the bird.

The purpose of this study was to compare the physiological effects of epinephrine injections to subsequent meat quality attributes. pinephrine concentration in the blood is increased during a natural stress reaction in the bird. When epinephrine is injected a maximum stress vel may be obtained.

A second part of the stress study was to introduce natural stress and to compare the physiological and meat quality data with the results om the chemical induced stress study.

In this study only results of the experiments to estimate chemical induced stress will be presented.

MATERIALS AND METHODS: Broilers chickens used in these experiments were reared at Spelderholt Centre. The trials were executed cording to the experimental set up given in table 1. Epinephrine was injected subcutaneously on the inner side of the thigh. All birds of a trial ere injected at the same time.

TRIAL	NUMBER of birds	AGE (days)	EPINEPHRINE INJECTION (mg/kg live weight)	STUNNING / KILLING TIME POST INJECTION (hours)
1	105	57	0.33	0, 0.5, 1, 2, 4, 8, 12, 16, 24, 30 and 48
2	105	64	4.0	0, 3, 6, 9 and 12
3	105	39	0.83	0, 0.5, 1, 2, 4, 8, 12, 16, 24, 30 and 48
4	105	46	1.5	0, 0.5, 1, 2, 4, 8, 12, 16, 24, 30 and 48

Table 1. Experimental set up of the experiments.

At the moment of slaughtering 8 birds were electrically stunned and killed. Blood samples were taken during bleeding of the birds for the estimation of glucose, lactate, triiodothyronin (T-3) and thyroxin (T-4). Immediately after killing from 4 out of 8 birds breast meat was sampled to measure initial pH, initial tissue lactate and initial tissue glycogen. One breast half of the other birds was used to measure ultimate pH, ultimate tissue lactate and ultimate tissue glycogen.
The other breast half from all 8 birds was used to measure Warner-Bratzler shear force and color.

Ph was measured according to the method described by Jeacocke (1977).

L* and a* color values were measured with the "Minolta Chroma meter II" Reflectance Colorimeter with a 8 mm measuring head.

Shear was measured using the Warner-Bratzler shear and an Overload Dynamics testing machine. The sampling and measuring method has been described by Froning and Uijttenboogaart (1988).

Glucose, glycogen and lactate were measured according to modified methods, based upon the enzymatic Boehringer Mannheim method described by Fletcher *et al*, (1991).
T-3/T-4 were measured with kits supplied by Diagnostic Products Corporation, Los Angeles, Ca, Usa

RESULTS AND DISCUSSION: The results of the meat quality determinations and muscle- and blood analyses are given in the figures 1 to 12.

Figure 1 and 2 show the initial and terminal muscle pH of the epinephrine treated birds. The values found initially do not show any significant differences. Terminal muscle pH significantly shows an effect of the treatment of the broilers with epinephrine. Birds slaughtered 4 to 12 hours after epinephrine administration show a increase in terminal muscle pH. The bird recovers after about 16 hours. This is in agreement with the data given in figure 10 (initial tissue glycogen) and 12 (terminal tissue lactate). Epinephrine administration causes a quick decrease in tissue glycogen and the terminal lactate concentration will be low. Under these circumstances the terminal pH will be relatively high. Terminal tissue glycogen was near 0 mg/kg for all the treated groups indicating that all the available glycogen has been transferred. A high initial glycogen content obviously results in a high lactate content in the muscle and thus in a low pH.

Meat quality characteristics are also affected by epinephrine administration. Especially the L* color value shows a decrease when broilers are slaughtered 4 to 12 hours after epinephrine administration. Under these circumstances the meat is darker. The a* color value (figure 4) is not significantly affected by the epinephrine administration. The Warner-Bratzler shear forces (figure 5) tend to show a decrease in value due to epinephrine administration in the period from 4 to 12 hours post mortem. The effect however is not shown to be significant.

The blood values for glucose, lactate, T-3 and T-4 are shown in figure 6 to 9. Blood glucose (figure 6) shows a significant increase in the birds killed between 0.5 and 8 hours after the injection. The blood lactate values (figure 7) are not affected. Only in trial 2 a very high value for blood lactate and also for initial tissue lactate (figure 11) has been monitored. In this trial the mortality during the period direct after epinephrine injection was very high.

Due to the increased metabolic rate in the animal caused by the administration of epinephrine the T-3 concentration in the blood was affected (figure 8). T-4 values (figure 9) were not. Further studies are required to explain these effects.

The results of these study have been the starting point for further study on the effects of natural stress on meat quality characteristics and metabolites in muscle and blood from stressed broiler chickens. Results of this study will be published in the near future (Fletcher, et al, 1991).

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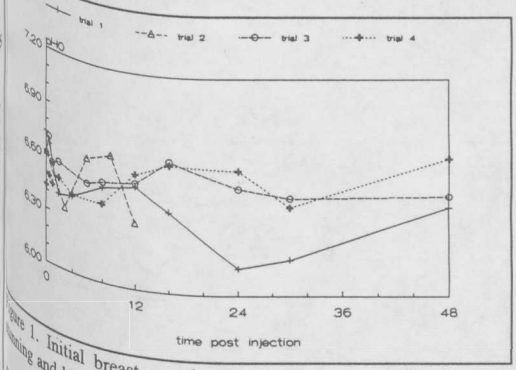

Figure 1. Initial breast muscle pH values measured directly after stunning and bleeding.

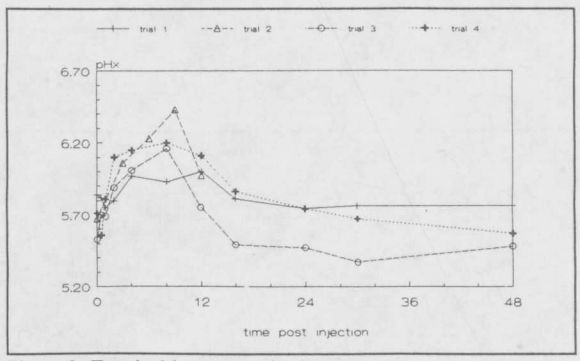

Figure 2. Terminal breast muscle pH.

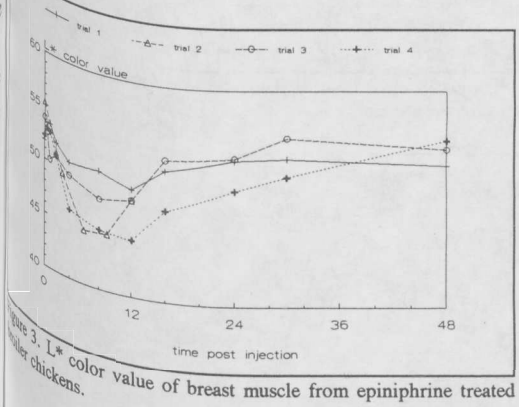

Figure 3. L* color value of breast muscle from epiniphrine treated broiler chickens.

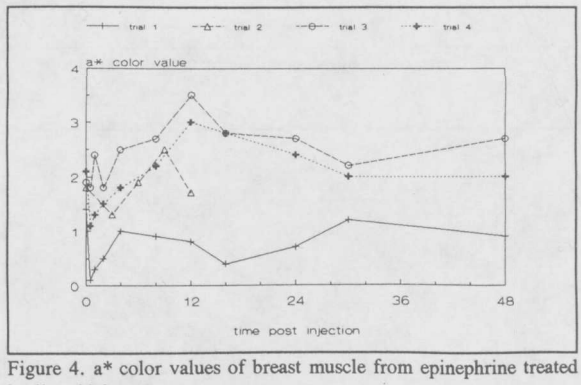

Figure 4. a* color values of breast muscle from epinephrine treated broiler chickens.

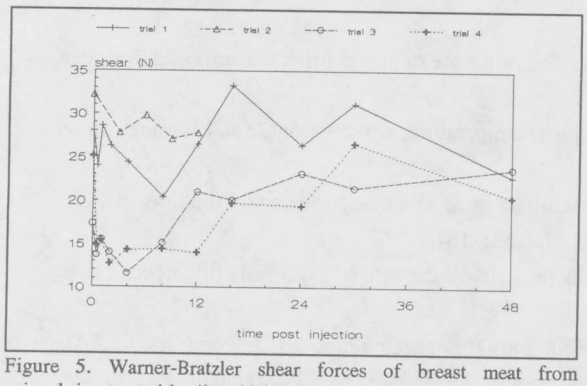

Figure 5. Warner-Bratzler shear forces of breast meat from epinephrine treated broiler chickens.

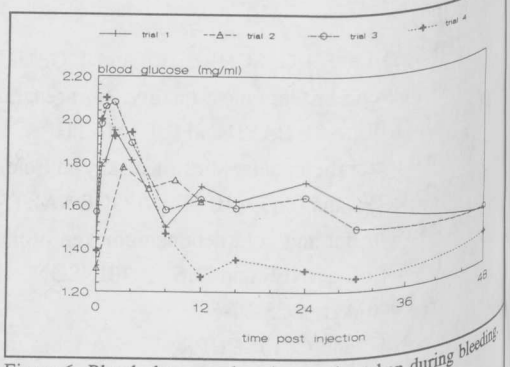

Figure 6. Blood glucose values in samples taken during bleeding.

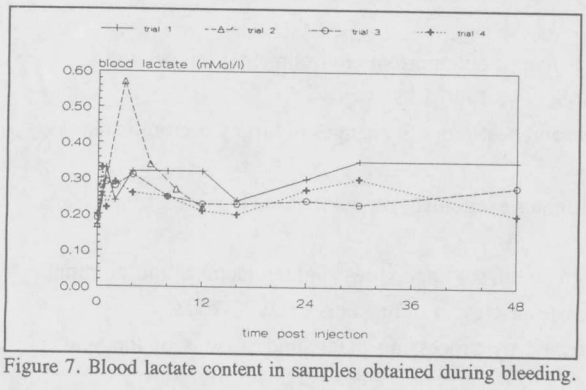

Figure 7. Blood lactate content in samples obtained during bleeding.

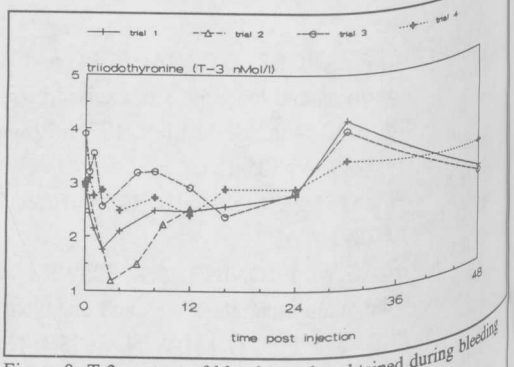

Figure 8. T-3 content of blood samples obtained during bleeding

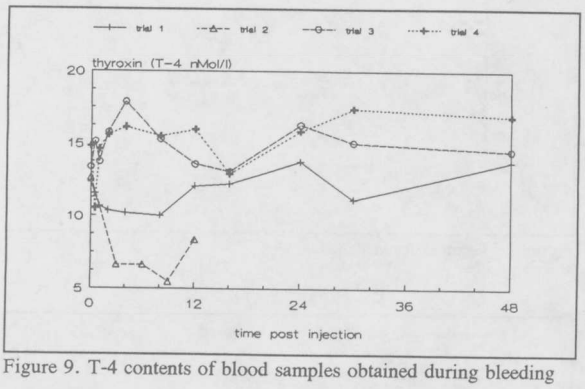

Figure 9. T-4 contents of blood samples obtained during bleeding

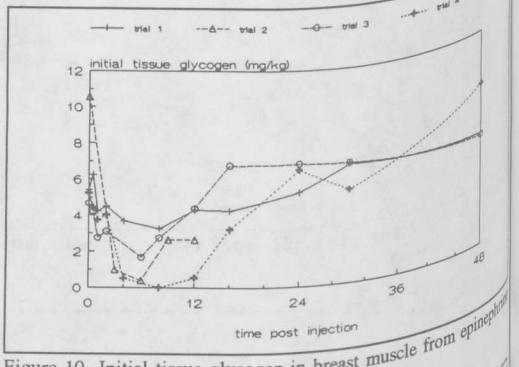

Figure 10. Initial tissue glycogen in breast muscle from epinephrine treated broiler chickens.

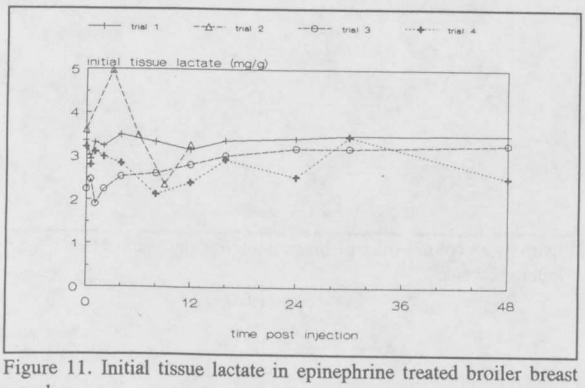

Figure 11. Initial tissue lactate in epinephrine treated broiler breast muscle.

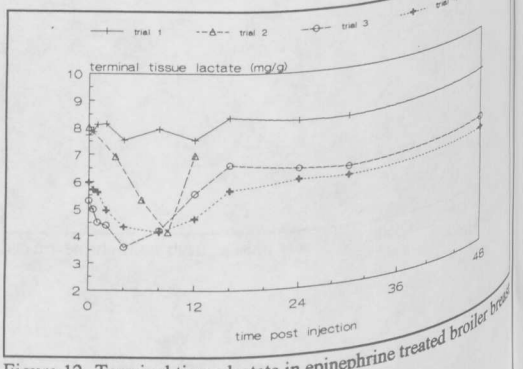

Figure 12. Terminal tissue lactate in epinephrine treated broiler breast muscle.