CARCASS AND MEAT QUALITY OF BROILER CHICKENS AT DIFFERENT STARVING PERIODS BEFORE SLAUGHTER

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Summary. The present study investigated the influence of varying lengths of starving periods on quality attributes of chicken meat. One hundred and eighty broilers of both sexes were divided into 6 groups, which were withdrawn from feed for 0, 2, 4, 8, 16 or 24 hours before slaughter. Slaughter took place without any stress caused by transport or waiting times. Six representative male and 6 female animals per group were selected for further studies. Data of slaughter weights, pH-values directly after slaughter and after 24 hours were collected. Meat samples were examined by a professional tasting panel. The level of significance was set to 5%. Increasing length of the starving period reduced body weight, mainly due to losses in breast and thigh meat. Both pH values rose slightly, but not sufficient to promote the development of DFD-meat. The tasting panellists preferred meat samples from animals with longer starving periods. The results indicate that the length of feed withdrawal has considerable positive influence on the sensory quality of the final meat product.

Key words: broiler chicken, meat quality, starving periods, slaughter quality, sensory quality

BROILERIŲ SKERDENŲ KOKYBĖ SKIRTINGAIS BADAVIMO PERIODAIS PRIEŠ SKERDIMĄ

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Santrauka. Šio eksperimento metu buvo tiriama badavimo periodo įtaka viščiukų mėsos kokybei. 180 abiejų lyčių broilerių buvo suskirstyti į 6 grupes. Tyrimai buvo atliekami 0, 2, 4, 8, 16 ir 24 val. prieš skerdimą. Skerdimo metu buvo išvengta streso, kylančio dėl transportavimo ar laukimo. Tolimesniems tyrimams buvo atrinkta po 6 vyriškos ir moteriškos lyties kiekvienos grupės atstovus. Skerdimo metu ir 24 val. po skerdimo gyvuliai buvo sveriami, matuojamas pH, buvo tiriami mėsos mėginiai. Tyrimų patikimumas buvo 5 proc. Ilgesnis badavimo periodas sąlygojo mažesnį krūtinės ir šlaunų svorį. pH nežymiai didėjo, bet nebuvo pakankamas stimuliuoti mėsos DFD. Tyrimams buvo pasirinkti gyvulių, patyrusių ilgesnį badavimo periodą, mėsos pavyzdžiai. Tyrimų rezultatai leidžia teigti, kad ilgesnis laikotarpis be maisto turėjo teigiamos įtakos mėsos produktų sensorinėms savybėms.

Raktažodžiai: viščiukai broileriai, mėsos kokybė, badavimo laikotarpis, skerdimo ir pojūčių kokybė.

Introduction. The consumption of chicken meat is of increasing importance in the EU and per head consumption is still rising. One reason for this case might be a more health-conscious nutrition by the consumers. Other reasons like the BSE problem or antibiotic abuse in pig production might also be important for an increase in consumption of chicken meat.

One of the main factors affecting chicken meat quality is a low microbial contamination. One way to reach a low microbial contamination is a starving period before slaughter, which is able to lower the risk of contamination with faeces. Also during slaughtering and there mainly by the carcass dissection a filled intestinal tract seems to effect a higher infection risk by pathogenic bacteria. Other reasons for starving periods before slaughtering are long transport routes from the producer to the slaughter house. A positive secondary effect of an empty intestine is a decrease in slaughter waste material.

For these reasons, the present study investigated the influence of varying lengths of starving periods on quality attributes of chicken meat.

Materials and Methods. 180 broiler chickens (Hybrid line Ross) were divided into 6 slaughter groups, which were split into two different pens of 15 animals per pen each. Over the 36 day feeding period, feeding regimen was similar for all groups, except for the variation of the duration of starving before slaughtering. Every pen had an area of 2m² and was scattered with wood shavings. All boxes were equipped with infrared lamps, feed and drinking automates. The stables were illuminated by the use of neon lights. In the first week the daily light period was 23 hours, in the second week 22

hours and in the third week 21 hours. The temperature was regulated with 2 ventilators. During the study, the experimental stable was regulated to the following temperatures: at start 27°C, in the second week 23°C and in the last week 20°C.

During the first 9 days of the experiment all chickens were fed with a starter diet, afterwards with a grower diet for 16 days and finally 10 days with a finisher diet. Throughout the experiment, feeding regimen was similar for all groups, except at the day before slaughter. At the 36th day, animals were withdrawn from feed for 0, 2, 4, 8, 16, or 24 hours, respectively.

Slaughter took place at the same time for all animals. For every single animal the time of feed withdrawal was calculated. In order to exclude a possible influence of stress, the chickens were stunned and slaughtered immediately after being taken out of the pens. At the end of the bleeding process the body weight was determined. Subsequently feathers, intestine, inner organs and the abdominal fat pad were removed. Afterwards carcasses were weighted again to get the eviscerated weight (warm). After a 24 hour cooling period eviscerated weight (cold) and oven-ready weight (= eviscerated weight (cold) without head, neck and feet) were recorded.

pH1 of the meat was determined immediately after slaughtering and pH2 after a 24 hour cooling period.

During slaughter, 6 male and 6 female animals with a comparable eviscerated weight (warm) of each slaughter group were selected as representatives for further analysis. The additional collected parameters from the 12 selected animals were determined from head, neck, feet, breast, thighs, wings and rest of body.

From all 72 animals the right breast and right thigh were tested for sensory quality. The tasting panel was split in groups of 11 and 14 tasters. Pieces of meat were tested grilled and without any additives for toughness, juiciness and flavour. Afterwards the meat pieces were ranked, whereas the best pieces got rank 1 and the worst rank 5. People of the tasting panel made a ranking of the different meat samples to get a rank sum for each of them.

The GLM procedure of SAS (SAS Institute, Inc. 1999) was used to determine treatment effects by analysis of variance (ANOVA). As a model a factorial variance analysis with interaction was taken. The used factorial stages were slaughter group, replication (box 1 and box 2 of the respective slaughter group) and sex. The means were compared using the Student-Newman-Keuls test. P-values lower than 0.05 were considered as significant.

Results und Discussion

Slaughter yield

Body weight was reduced significantly ($p < 0.05$) after a starving period of more than 4 hours (Table 1). This reduction was mainly due to a lower breast (after a starving period of 24 hours significantly decreased down to 91% of the control group) and thigh yield (lowered to 92%). In combination with measurements of eviscerated weight (warm), a great part of the bodyweight loss appears to be caused by defecation of the gut. The decrease of the difference between bodyweight and eviscerated weight (warm) seems constant approx. at the 16th hour, because the amount of chyme is constant. This could be the reason why slaughter waste during an increase in starving period will be non-varying, although the slaughtering weights decrease (Van der Wal et al., 1999). The results of this experiment agree with data of Buhr et al. (1998) indicating a decrease in slaughtering weight of 7.36% to 9.49% by a 24 hour starving period. Rasmussen and Mast (1989) also got similar results in their experiment. During an 18 hour starving period the body weight decreased about 5.40% but body weights were not significantly reduced. Similar results were observed by Lyon et al. (1991), Wabeck (1972), Benibo and Farr (1985) and Jensen et al. (1984). Therefore it appears that a decrease in bodyweight is not only a result of an increase in degradation of intestine tract.

Table 1: Slaughter weights (percent of the control group (no feed withdrawal))

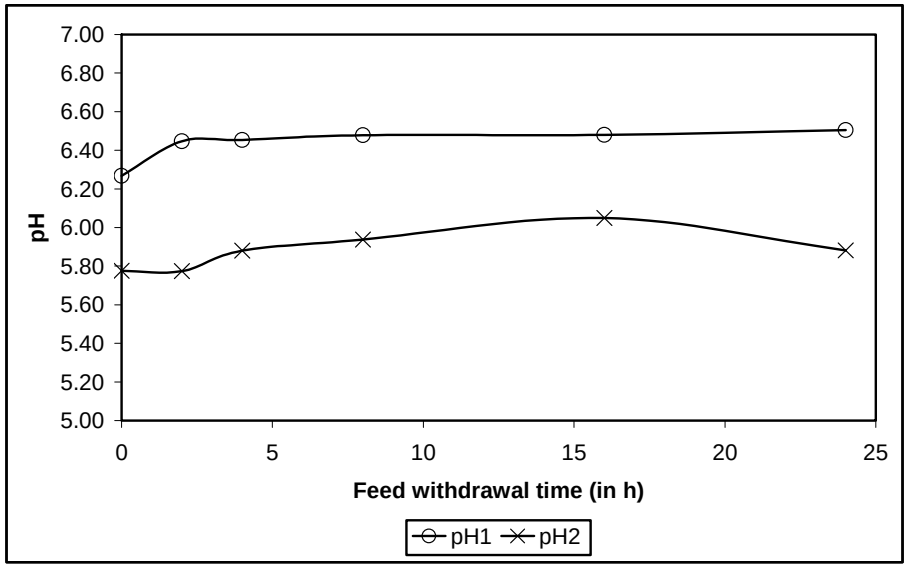
	Feed withdrawal time (in h)					
	0	2	4	8	16	24
Body weight (after bleeding)	100 ^{a}	100.6 ^{a}	99.2 ^{a}	94.1 ^{b}	90.8 ^{b}	90.9 ^{b}
Head and neck	100	95.7	98.9	94.6	96.7	98.9
Feet	100 ^{a}	87.0 ^{b}	85.7 ^{b}	83.1 ^{b}	81.8 ^{b}	81.8 ^{b}
Breast	100 ^{a}	99.1 ^{ab}	95.1 ^{ab}	94.0 ^{ab}	92.2 ^{ab}	90.7 ^{b}
Thighs	100	99.1	98.7	95.5	98.9	92.4
Wings	100	102.4	102.4	98.8	97.6	100.0
Rest of body	100	100.0	102.7	96.2	96.2	93.3
Eviscerated weight (warm)	100 ^{a}	100.9 ^{a}	101.2 ^{a}	96.6 ^{ab}	93.4 ^{b}	94.2 ^{b}
Abdominal fat pad	100 ^{ab}	103.6 ^{a}	95.5 ^{ab}	93.8 ^{ab}	92.6 ^{ab}	84.7 ^{b}
Heart	100 ^{a}	101.1 ^{a}	101.1 ^{a}	90.2 ^{ab}	90.2 ^{ab}	88.0 ^{b}
Liver	100 ^{a}	103.9 ^{a}	99.8 ^{a}	82.5 ^{b}	77.2 ^{b}	82.5 ^{b}
Stomach	100	92.9	94.2	100.9	96.4	96.4
Eviscerated weight (cold)	100 ^{a}	100.2 ^{a}	99.6 ^{a}	95.4 ^{ab}	92.8 ^{b}	93.0 ^{b}
Oven-ready weight	100 ^{a}	100.9 ^{a}	100.3 ^{a}	96.0 ^{ab}	93.4 ^{b}	93.5 ^{b}

$^{a, b}$ Within a row, means without a common superscript differ ($P < 0.05$)

Lower body weight was mainly influenced by variations in the weight of breast and thigh meat. Bartov (1998) got similar results in his experiment. Due to a prolonged starving period, weight of breast meat was reduced by approx. 10% in his study. In the present experiment, the weight of the abdominal fat pad was also decreased remarkably ($p < 0.05$) by a prolonged starving period, what agrees with data of Demir et al. (2004). Breast meat results are comparable to thigh. Heart weight lost 10% during a 24 hour starving period. Liver weight remained constant until a 4 hour feed withdrawal. After 8 hours feed withdrawal, liver weight was significantly ($p<0.05$) lower (20%) than in the control group. Stomach weights showed no differences between experimental groups. These results agree with Trampel et al. (2005), Jensen et al. 1984 and Buhr et al. (1998), which also found a decrease in liver weight between 10% and 22% at a time of feed withdrawal from 8 to 24 hours.

pH-values

Figure 1 shows both pH values, directly after slaughter and after the 24 hours cooling period. As the time of feed withdrawal increased, pH1 value increased slightly from about 6.30 to 6.50, but pH2 increased significantly ($p<0.05$) from approx. 5.80 without feed withdrawal to a maximum value of just over 6.00 after a 16 hour feed withdrawal. Those results are in contrast to Kotula and Wang (1994), which observed a decrease in pH1 in breast meat and in thigh of 0.27 and 0.34 units, respectively, after a 24 hour starving period. After 24 hours of cooling storage there was a significant difference in pH-value. Sams and Mills (1993) observed in their study that the pH value during a 5 hour starving period rose slightly. From 5 to 10 hours there was no further increase. This effect could be explained by the fact, that by starving periods below 5 hours the glycogen content in the muscle will decrease and at 10 hours the fatty acid oxidation increases. Fatty acid oxidation is more efficient than glycolysis and therefore feed withdrawal reduces pH values. The present experiment also showed a slight increase of the pH-value at 2 to 4 hours of starving period. This confirmed the hypothesis of Sams and Mills (1993). Edwards et al. (1999) reported that different slaughter techniques might have an important influence on the glycogen content in muscle tissue. It seemed that slaughtering by decapitation caused a high contraction of muscles and as a result the glycogen reserves decreased for about 23%. After slaughter, subsidence of pH value is independent from glycogen content in muscle. So it seems that it is not possible to produce DFD-meat only by different starving periods.



pH1……..pH value directly after slaughter
pH2……..pH value after 24 hours of cooling storage

Figure 1. **pH-values**

Sensory test

The sensory quality (delicateness, juiciness and flavour) was determined by two professional tasting panels. The resulting ranks of sensory quality showed some differences between the two tasting groups (Figure 2). Group 1 arranged the assay with 0, 2 or 24 hours of feed withdrawal higher than group 2. The mean rank sum showed a slight tendency in favour of the longer feed withdrawal times.

These results indicate that the length of feed withdrawal has a considerable positive influence on the sensory quality of the final meat product, but the elevation of pH values in combination with pre-slaughter stress situations might lead to DFD-meat.

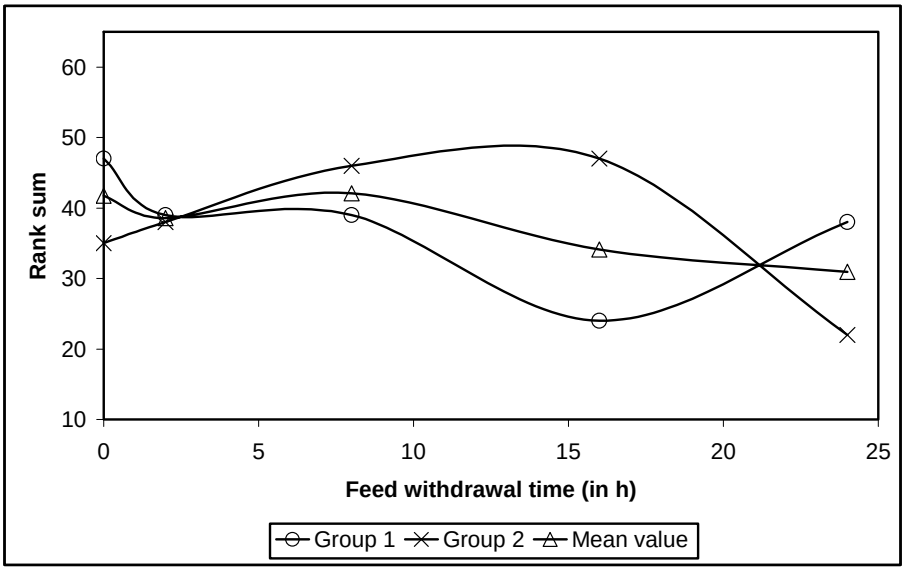


Figure 2. **Rank sum of sensory test**

Conclusion:

Body weight was reduced significantly, mainly due to a lower breast and thigh yield. Both pH-values, directly after slaughter and after 24 hours of cooling storage, rose very slightly, as the time of feed withdrawal increased. The rank sum showed a slight tendency in favour of the longer starving period. The results indicate that the length of feed withdrawal has considerable positive influence on the sensory quality of the final meat product, but the elevation of pH-values in combination with pre-slaughter stress situations could lead to DFD-meat. In summary the results are not questioning the technical processing advantages of feed withdrawal.

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