THESIS OF THE PH.D. DISSERTATION

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PRODUCTION POSSIBILITIES BASED ON THE MATERNAL LINE OF THE YELLOW HUNGARIAN HEN

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1. AIMS

In the recent decades because of the alternative poultry meat production technologies (free range and organic farming), which are gaining ground in some of the European countries, only special slow growing breeds and hybrids can be used. The aim of the examinations mentioned in the study was to establish whether the end products created by crossing the Yellow Hungarian hen with different meat type cocks were suitable for alternative keeping technology.

The valuable meat parts of the pure bred Yellow Hungarian kept in free range for 84 days and the end product created with crossing as well as the valuable meat parts of Ross 308 broilers fattened for 42 days in intensive keeping technology were thoroughly examined in order to establish whether the genotype and/or keeping technology has any kind of influence on the weight of the end products, the different chemical parameters, the cooking loss, the colour and textual qualities of the meat. This also showed that in case of being traded how and to what extent the inner content parameters of the valuable meat parts of the products made from free-range bred chicken differ from that of the Ross 308 broiler kept under intensive conditions.

2. MATERIALS AND METHODS

During the experiment examinations were carried out on five crossing partners (S 77, Foxy Chick, Redbro, Hubbard Flex, Shaver Farm), and as control pure bred Yellow Hungarians and Ross 308 broiler kept under intensive conditions and bought from producers were examined. Two repeated tests were carried out for the Yellow Hungarian x Hubbard Flex, Yellow Hungarian x Shaver Farm and the Ross 308 hybrid, for the Yellow Hungarian x Redbro and the pure bred Yellow Hungarian three repeated tests were made.

The end product stocks created with crossing and the pure bred Yellow Hungarian stock were fattened in free range (until 6 weeks of age indoors, from week 6 until day 84 outdoors) at the Animal Breeding and Feeding Research Station of the University of West Hungary Faculty of Agricultural and Food Sciences. Individual weighing was carried out on day one, day 21, 56 and 84 (for the last two times separately according to sexes), and the feed conversion capacity of the different genotypes was also examined. The breeding period for the intensively fattened Ross 308 broilers lasted 42 days.

At the end of fattening for each repeated tests three pullets and cocks each were selected for test slaughter on the basis of average weight from the crossed genotypes, the Yellow Hungarian and the Ross 308 hybrids. The live weight, weight after de-bleeding, the weight after plucking, the ready to cook weight, the weight of the valuable meat parts (breast, thighs) and that of the valuable inner organs (liver, heart and gizzard), as well as the weight of the abdominal fat content were measured.

The chemical analysis of the feed and that of the meat samples (dry matter, protein, fat, fibre and ash content) were determined according to the methods suggested by the Hungarian Feed Codex at the laboratory of the Department of Animal Nutrition of the University of West Hungary Faculty of Agricultural and Food Sciences.

The determination of the cooking loss was made in accordance with the suggestion of the National Meat Research Institute using the following method: pieces were cut from each sample of the bony breasts and the thighs which filled a can of 250 cm^3 completely. The meat samples were weighed, canned and were closed with a capping machine. The cans were heat treated in a bath of 75 °C for a period of 1 hour. After the treatment the cans were cooled under running water and were kept in a refrigerator for one day. After opening the cans the samples were defrosted, dried and their weight was measured. The ratio of the weight after cooking and that of the raw meat subtracted from 100 indicated the cooking loss.

The instrumental colour measurement of the breast and thigh meat was carried out using a Minolta CR-300 at the University of Szeged Faculty of Engineering Institute of Mechanical Engineering. During measurement the lightness (L*), redness (a*), yellowness (b*) values of the meat were measured for the breast samples on 6 different locations each, and on the thigh samples on 12 locations each, and on the basis of the latter two parameters the croma value (C*) indicating the brightness and the density of the colour was calculated. Moreover the colour difference values ($\Delta E^*_{a;b}$) were calculated at the breast and thigh meat for the genotypes examined using the following formula:

$$\Delta E^*_{a;b} = \{ (L^*_1 - L^*_2)^2 + (a^*_1 - a^*_2)^2 + (b^*_1 - b^*_2)^2 \}^{1/2}$$

L^*_1; L^*_2= the lightness;
a^*_1; a^*_2= the redness;
b^*_1; b^*_2= the yellowness of the meat of the two samples compared.

Based on the colour difference values ($\Delta E^*_{a;b}$) it could be established to what extent the variations experienced in the measured parameters (lightness, redness, yellowness) between the different genotypes could be percepted by human vision (Table 1).

Table 1

The relationship between $\Delta E^*_{a;b}$ and human vision

$\Delta E^*_{a;b}$ value	**The perception of colour differences by human vision**
$\Delta E^*_{a;b} \leq 0,5$	It is not noticeable
$0,5 < \Delta E^*_{a;b} \leq 1,5$	Hardly noticeable
$1,5 < \Delta E^*_{a;b} \leq 3,0$	Noticeable
$3,0 < \Delta E^*_{a;b} \leq 6,0$	Well visible
$6,0 < \Delta E^*_{a;b}$	Large

The textural characteristics of the breast samples were examined using an instrument similar to the Stevens QTS 25 penetrometer at the University of Szeged Faculty of Mechanical Sciences Institute of Food

Engineering. The measurements were carried out on the breast samples on three locations each, using the non-destructive TPA method, a steel head with a diameter of 6 mms, with a target value of 5 mms and at a speed of 50mm/minutes. From the data given by the machine the hardness, gumminess and chewiness values of the breast meat were determined.

Data processing was evaluated using Microsoft Excel 2003 and Statistica Statsoft 7.1 computer programs.

3. RESULTS AND DISCUSSIONS

3.1. Production parameters

The production parameters showed that the end products stocks created with the crossing of Yellow Hungarian hens and meat type cocks can reach even twice the live weigh of pure bred Yellow Hungarian stocks within an 84 day period in mixed sexes. The live weight for pure bred Yellow Hungarian was an average of 1031 grams, while for the genotype of Yellow Hungarian x Hubbard Flex it reached 2193 grams, but from the crossed stocks even for the Yellow Hungarian x S 77, which gave the worst results, a live weight of 1511 grams was measured. It should, however, be mentioned that for the crossed stocks considering the live weight a far wider coefficient of variation showed, which means that the growth of the live weight has a disadvantageous effect on the uniformity, which could be a disadvantage from the point of slaughter.

As far as feed conversion capacity was concerned a significant diversion – almost 1 kilograms of feed/body weight kilograms – showed among the different genotypes. For the pure bred Yellow Hungarian 3.31, for the F_1 population a rate between 2.65-3.63 kilograms/kilograms was measured. This rate lags far behind the rate common in intensive fattening, and clearly derives from the differences in the keeping technology.

3.2. Carcass yield

When examining the slaughter parameters the influence of keeping technology could be shown in the ratio of the weight of de-bleeding and plucking to that of the live weight, however, no significant difference was measured. For the ready to cook weigh as a ratio of the live weight and the ratio of the breast weight to the ready to cook weight a value of 10-12 percentage points higher was calculated for the Ross 308 broilers than for the end products kept in free range, and the pure bred Yellow Hungarian, while the thigh weight ready to cook weight was 2.5-5.6 percentage points lower. The differences in the ratio of the ready to cook weight vs. live weight and the breast weight vs. ready to cook weight are mainly attributed to the genotype, while the differences manifested in the ratio of the thigh weight vs. ready to cook weight are clearly attributed to the keeping technology (a higher rate of muscle growth in the thighs as a result of more intense activity).

The examination of the proportion of the valuable internal organs (liver, heart, gizzard) to the live weight showed significant differences in case of the ratio of gizzard vs. live weight between the free-range and the intensively fattened Ross 308 stocks (0.76 % vs. 2.20 %). This could also be a result of the difference in feeding which comes from the keeping technology (free range technology).

Genotype and keeping technology clearly had an influence on the abdominal fat content. For the free range technology in case of the pure bred Yellow Hungarian no, or insignificant amount of abdominal fat was found, while for the F_1 end products the proportion of abdominal fat to the live weight was between 0.19-0.54 %, while for the Ross 308 broilers kept under intensive conditions it reached 1.12 % for mixed sexes.

3.3. Chemical analyses of the valuable meat parts

There was no significant difference among the dry matter content of the breast meat of certain genotypes, the value measured was between 24.85 and 26.86 %. On the contrary, however, due to the higher raw fat content the dry matter content of the thigh meat of intensively fattened Ross 308 was 33.08 % (for mixed sexes) exceeding by 5.28-7.48 percentage points the same indicator of the thigh meat of chicken kept free range.

The extreme values of protein content of breast meat was between 21.14 and 25.03 % for mixed sexes 18.01 and 19.63 % for thigh meat. No proof could be found for this parameter either as far as keeping technology or sex was concerned.

The fat content of Ross 308 broilers was 1, that of the thigh meat 7 percentage points higher than the fat content of the Yellow Hungarian and the F_1 kept in free range. Therefore genotype and keeping technology has a significant impact on this from the point of nutrition biology important parameter.

The ash content of chicken fattened free range was twice (0.99 %) the amount of the Ross broilers (0.53%), which allows the conclusion that free range stocks have a higher macro element content. For the ash content of thighs – even though the influence of keeping technology and that of the sex could statistically be proven – there was a much slighter variation (for the chicken kept free range it was 0.90 % for the Ross 308 broilers 1.03 %).

3.4. Examination of the colour of valuable meat parts

The lightness value (L*) of Ross 308 broilers fattened in an intensive way was 6.74 percentage points lower than that of the chicken kept free range 51.93 points vs. 58.67. The redness value (a*) was significantly high for the pure bred Yellow Hungarian and for the Yellow Hungarian x Hubbard Flex genotypes (4.20 and 3.84 points). The yellowness value (b*) of the breast meat was highest for the pure bred Yellow Hungarian and Yellow Hungarian x Shaver Farm (7.24 and 6.47 points). The croma value (C*) calculated from the redness and the yellowness values was for the pure bred Yellow Hungarian the highest (8.44 points). The superiority of the free range stocks could be statistically proven for all four examined indicators (lightness, redness, yellowness, croma).

For the different genotypes as opposed to the breast meat smaller variance was measured for the parameters qualifying the colour of the thigh meat. The lightness value (L*) was between 52.29 (Yellow Hungarian x Hubbard Flex) and 54.72 (pure bred Yellow Hungarian), the redness value (a*) was between 10.34 (Ross 308) and 11.90 (pure bred Yellow Hungarian), the yellowness value (b*) was between 6.37 (Yellow Hungarian x Hubbard Flex) and 8.73 (pure bred Yellow Hungarian). The croma value (C*) was for the pure bred Yellow Hungarian the highest the same way as for the breast meat. The influence of keeping technology could only be statistically proven for the redness value, for the chicken kept free range a much higher value could be measured.

The colour difference values showed that compared to the other genotypes the breast meat of Ross 308 broilers and pure bred Yellow Hungarian in mixed sexes differed *well visibly* and to a *large extent* not considering the difference between the pure bred Yellow Hungarian and the SM x SF, moreover between the crossed genotypes there was a *well visible* variation. The colour difference values of the thigh meat samples were smaller compared to that of the breast meat, the variations calculated were *noticeable* or *hardly noticeable*. For the pullets and the cocks these two indicators were present almost to the same extent, however the *noticeable* variation was more dominant for the cocks.

3.5. Examination of the cooking loss of meat

The cooking loss of chicken meat was between 10.13 and 11.68 % for the genotypes respectively, which was almost double to the cooking loss measured for Ross 308 broilers (5.24%), therefore on the basis of this parameter it could be concluded that from the point of further processing the large-scale roast chicken meat has more favourable characteristics. On the basis of the results it can be concluded that genotype and keeping technology have a clear influence on the cooking loss of meat.

3.6. Examination of the textural characteristics of breast meat

The hardness, gumminess and chewiness value of breast meat was higher for free-range chicken than for the broilers fattened in an intensive way. For free-range end products the hardness value measured was 865.5 grams for Ross 308 chicken it was 209.3 grams. The gumminess and chewiness values were – in the same order – 353.4 and 151.8 grams, and 1154.7 and 476.7 units. For all three parameters the influence of genotype and keeping technology could statistically be proven.

4. NEW SCIENTIFIC RESULTS

1. From the examinations it could be shown that for the crossed (Yellow Hungarian hen mother line x meat type hybrid cock) the growing vigour was better than for the purebred Yellow Hungarian breed, however breeding has a negative influence on the uniformity of the stock.
2. The ratio of the breast weight to ready to cook weight of light scale broiler chicken is far ahead to that of any of the crossed stocks, the chicken fattened free range (F_1 crossing) statistically reached a higher ratio of thigh weight to ready to cook weight.
3. The protein content of the Yellow Hungarian breed roast chicken is not lower than that of the breast meat of large-scale broilers, at the same time at a level of $P \leq 0.05$ the raw fat content shows a far lower value.
4. During the examinations it was proven that on the basis of lightness values the breast meat of large-scale animals was darker, which was statistically proven at a level of $P \leq 0.05$. The redness and yellowness values of breast meat were higher for the yellow Hungarian and for some of the crossed F_1 stocks than for the large-scale roast chicken stocks, while no such variance was experienced for the colour values of thigh meat.
5. On the basis of the croma value, which well characterises the colour of the meat, the density of the yellow Hungarian roast products was at a level of $P \leq 0.05$ statistically proven to be the most expressive.
6. The colour difference values showed that compared to the other genotypes the breast meat of Ross 308 broilers and purebred Yellow Hungarian in mixed sexes differed *well visibly* and to a *large extent*,

moreover between the crossed genotypes there was a *well visible* variation. The colour difference values of the thigh meat samples were smaller compared to that of the breast meat.

7. On the basis of the fattening parameters, and on the meat and stock examination results the yellow Hungarian x Redbro crossing could be suggested as an alternative to replace the free range hybrids imported from abroad.

5. LIST OF PUBLICATIONS MADE IN THE THEME OF THE DISSERTATION

BOOKS AND BOOK CHAPTERS

Kovácsné Gaál K. – Konrád Sz. (2006): A sárga magyar tyúk hasznosításának lehetősége keresztezéssel. In: Mihók, S. (szerk.) Génmegőrzés. Debreceni Egyetem Agrártudományi Centrum, Debrecen. p. 215-235.

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Konrád Sz. – Kovácsné Gáal K. – Bali Papp Á. (2007): A sárga magyar tyúk anyai vonalra alapozott keresztezéseinek eredményei. Animal welfare, etológia és tartástechnológia. 3. 3. p. 198-218.

Konrád Sz. – Kovácsné Gaál K.: Különböző genotípusú és tartástechnológiájú pecsenyecsirkék mell- és combhúsának kémiai analízise. Acta Agraria Kaposvariensis (in press),

REFEREED JOURNAL ARTICLES IN FOREIGN LANGUAGE

Konrád Sz. – Kovácsné Gaál K. – Vitinger E.: The effect of genotype, keeping technology and sex on the textural attributes of chicken meat. Állattenyésztés és Takarmányozás (in press)

ABSTRACT COMMUNICATIONS:

K. Gaál – O. Sáfár – Sz. Konrád (2004): Die Nutzung des einheimischen ungarischen gelben Huhns unter natürlichen Haltungsbedinungen; In.: 11. Freiland-Tagung/17. IGN-Tagung, Wien, Österreich, 23-25. September 2004, Auf dem Weg zu einer tiergerechten Haltung, p. 79.

Konrád Sz. – Kovácsné Gaál K. (2006): Sárga magyar tyúk anyai vonalra alapozott keresztezéseinek eredményei kifutózott tartástechnológiában. XXXI. Óvári Tudományos Nap: Élelmiszer alapanyag-előállítás – Quo vadis? Mosonmagyaróvár, 2006. október 5. Előadások és poszterek összefoglaló anyaga. Állattenyésztési szekció. 44. o.

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POSTER PRESENTATIONS:

K. Gaál – O. Sáfár – Sz. Konrád (2004): Die Nutzung des einheimischen ungarischen gelben Huhns unter natürlichen Haltungsbedinungen; 11. Freiland-Tagung/17. IGN-Tagung, Wien, Österreich, 23-25. September 2004