PhD THESIS

The caponization of self-sexable hybrid chickens grown in traditional husbandry system and its effect on the quality of meat

SUMMARY OF Ph.D. THESIS

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INTRODUCTION

Capons meat is found very little on the tables of Romanians, although in other countries of the European Union it is a tradition. In today's industrial chaos, producing capons meat can be a niche business. From ancient times, the organoleptic qualities of capon meat are known, so to capitalize on the male youth obtained by hybridization, castration would be a solution to consider. Most countries use for castration roosters of slow-growing native breeds, so hybrids through the heterosis phenomenon that manifests in them could positively influence the growth spurt. Claponage is practiced very little in Romania, much less in the idea of bringing for sale capon meat, thus, in order to be able to form capon farms and make them economically profitable, it is essential to use hybrids with good growth and with a commercial aspect of the carcass (well proportioned, with a wide chest and a light skin), which can be lotized early, and for the surgery on the removal of the testes, an optimal moment of age of the cocks should be sought in order to increase the percentage of survival after the intervention and to decrease the recovery period. Thus, the capon, also called the caviar of domestic birds, becomes interesting again due to the tendency of the meat market to create new food niches of ecological and traditional character.

Romania could become a good producer of this organic bird, exceptionally tasty and very well paid.

After the intervention regarding the removal of the testes we follow the development of the capons compared to the development of non-castrated hybrid cocks under the same environmental and fodder conditions, and to obtain a high quality meat we chose a long-term growth, in an open environment and with natural cereals that allow the capons to have access to sufficient movement, the possibility to shorten and consume fresh vegetation at discretion, thus creating a natural environment for the birds to grow, taking into account the increase of their well-being. In order to adapt to the environmental conditions described above and to obtain a tender and tasty meat, we chose to obtain a hybrid with good cutting yield that is also self-sexable from the crossbreeding of two mixed breeds with very good meat production, good cutting yield and a tender and tasty meat, which have a remarkable resistance to environmental conditions and diseases, because in the extensive (traditional) husbandry system that we have chosen the biosecurity conditions cannot be accomplished as in a controlled environment, there is thus a risk that birds will come into contact with different pathogen-carrying vectors. The breeds chosen by us for crossbreeding in order to obtain the self-sexable hybrid are: roosters of the Rhode Island Red breed and females of the Barred Plymouth Rock breed.

THESIS STRUCTURE

The Ph.D. thesis entitled ”The caponization of self-sexable hybrid chickens grown in traditional husbandry system and its effect on the quality of meat” comprises a number of 142 pages and presents an iconography totaling 63 of figures and 23 of

tables. It is structured into two parts and it is made in accordance with the drafting rules of IOSUD USAMV-Cluj Napoca.

The first part of the thesis consists of 33 pages and it is structured in four chapters.

Chapter I, entitled "Poultry breeding" includes information on poultry rearing systems, mixed breeds of chickens, as well as obtaining self-sexable hybrid chicks.

Chapter II – "Caponization and its influence on the quality of meat" presents the anatomical features of birds and recommendations regarding the surgical technique, as well as the effects of caponization on testosterone levels, histology, lipid localization and the diameter of muscle fibers, and on the growth performance and chemical composition of meat.

Chapter III – "Quality parameters of poultry meat" includes information on the quality, organoleptic characteristics, chemical composition, pH, colour and appearance of poultry meat.

Chapter IV – "Specific norms" presents the specific rules in force on the quality and safety of capons meat.

The second part of the thesis is structured in 6 chapters, spanning 87 pages, and includes data about the working hypothesis, pursued objectives, used materials and methods, as well as information on the production of capons, morphometric features and investigations for the assessment of the quality of their meat. This part of the paper concludes with the chapters containing general conclusions, aspects of originality and innovative contributions.

THE MANUSCRIPT OBJECTIVES

1. Obtaining the capons from self-sexable hybrid roosters and growing them in traditional system in order to evaluate the colour and pH of their meat in comparison with the colour and pH of the meat of intact self-sexable hybrid roosters:

- Obtaining a self-sexable hybrid and its importance;

- Their growth and development up to the optimal age for caponization;

- Castration of obtained males at different ages;

- Appreciation of morphometric differences (bird/carcass) in the two batches of castrated hybrid chickens and intact chickens grown in traditional system;

- Determination of parameters such as: colour and pH of the thigh muscles and breast muscles from castrated and, respectively, intact hybrid chickens.

2. Chemical composition and histological examination of the meat of castrated self-sexable hybrid chicken and meat of intact self-sexable hybrid chicken grown in traditional system:

- Determination of chemical parameters such as: moisture, fat, protein and collagen in thigh muscles and pectoral muscles from castrated and intact hybrid chickens;

- Histological examination of the thigh and breast muscles and various organs in castrated hybrid chickens compared to intact hybrid chickens, with the quantification of the presence and distribution of adipocytes.

MATERIALS AND METHODS

Chapter VI entitled ***"Materials and methods"*** provides information about: biological material and other types of materials, equipment, as well as how to organize the investigation. The research was carried out on 28 self-sexable hybrid cocks, raised in their own household in traditional husbandry system and slaughtered for family consumption.

RESULTS AND DISCUSSIONS

Chapter VII entitled ***"Obtaining capon from self-sexable hybrid cocks and growing them in traditional system in order to assess the colour and pH of their meat in comparison to the colour and pH of the meat of intact self-sexable hybrids cocks"*** includes research focusing on obtaining the self-sexable hybrid, its growth and adaptation to the traditional (extensive) husbandry system, the suitable castration method and, thus, finally, a carcass with a commercial appearance. For this purpose, the following objectives have been proposed:

- Obtaining a self-sexable hybrid and its importance;

- Their growth and development up to the optimal age for caponization;

- Castration of obtained males at different ages;

- Appreciation of morphometric differences (bird/carcass) in the two batches of castrated hybrid chickens and intact hybrid chickens grown in traditional system;

- Determination of parameters such as: colour and pH of the thigh muscles and breast muscles from castrated and, respectively, intact hybrid chickens.

Following the performed investigations, the following conclusions were established:

It has been proven that obtaining a self-sexable hybrid is important in order to prepare it for caponization, thus, the obtained hybrid has a much better growth than the mixed breed chickens it was obtained and the fact that it is self-sexable helped us to lotify the male chickens from the first day of life and to prepare them for an early caponization.

Another aspect to mention is that we have carried on and obtained is the colour of the skin of the self-sexable hybrid of the males that is light (yellow) with a more commercial appearance, examined by the sensory method.

Our capons are morphologically different from the control group of hybrid intact chickens, and the chosen surgical techniques applied to 3.5-month-old chickens had very good results. Castration of hybrid cocks at the age of 9 months had very poor results.

Our study showed a positive effect of caponization in terms of weight gain of the carcass of hybrid castrated chickens compared to the intact ones.

The aspects encountered at the sensory examination of the two types of carcasses were demonstrated by the determinations made with the Mini Scan EZ Hunter Lab spectrophotometer, thus higher values of brightness (L* scale) and shades of yellow (b* scale) were detected in thigh muscles of hybrid castrated chickens comparing to the thigh muscles of intact hybrid chickens. We identified differences in the shades of yellow (b* scale) of the breast muscles, recording higher values in the meat of castrated chickens, compared to the intact ones.

The thigh muscles of castrated hybrid chickens have a light red colour which is a quality indicator. The thigh muscles of intact hybrid chickens have a much darker colour, showing higher a* scale values compared to the meat obtained from castrated hybrid chickens.

Although other studies show that pH influences the colour of the meat, in our case at very close pH values taken from the thigh muscle in both castrated chickens, as for the intact ones, we noticed different colours of the thigh muscles.

We can conclude that by caponization the colour of the muscles is influenced, so the capons have a lighter (L*), yellower (b*) and a lighter red(a*) muscle colour.

Chapter VIII entitled ***"The chemical composition and histological examination of the meat of castrated self-sexable hybrid chickens and the meat of intact chickens reared in traditional husbandry system"*** aimed to obtain, after the caponization, a high quality meat, much tastier and tenderer than the meat of an intact chicken.

In order to check whether qualitative changes occur in the meat of the castrated hybrid chicken compared to the meat of the uncastrated hybrid rooster and taking into account the way the fat tissue is disposed in the bird carcass we have proposed the following objectives:

- Determination of chemical parameters such as: moisture, fat, protein and collagen in the thigh muscles and breast muscles from castrated and intact hybrid chickens;

- Histological (histopathological) examination of meat of the thigh and breast muscles and various organs in castrated hybrid chickens compared to intact hybrid chickens with the quantification of the presence and distribution of adipocytes.

The following conclusions were drawn after the carried out investigations:

Regarding the compositional changes, a significant difference in collagen between the two types of meat without skin was observed. Castrated hybrid chicken meat has a much lower collagen value than the intact hybrid chicken meat. From the reports of other studies we find out that an increased collagen value decreases the general nutritional value of meat, and the tenderness and texture of the meat are negatively influenced by the increased collagen. A smaller difference is also seen in the protein content of castrated hybrid chicken meat, so we can report that the trophic-biological value is not neglected in the meat of castrated hybrid chicken.

Considering the fact that the distribution of adipose tissue in the bird is disposed subcutaneously and less among muscle fibers, we measured the thickness of subcutaneous adipose tissue in the brast and thigh in both castrated and intact hybrid chickens, thus we found that the average thickness of subcutaneous adipose tissue both at the breast level, as well as the thigh of castrated hybrid chickens is much higher

compared to the average thickness of subcutaneous adipose tissue in the breast, respectively the thigh muscles of intact hybrid chickens. We can thus state that by caponization the amount of fat disposed subcutaneously significantly increases.

No significant differences were found in the fat content of skinless meat in 7.5-month-old castrated hybrid chickens compared to intact ones.

Another aspect to mention would be that the average thickness of adipose tissue disposed in the proximity of the sciatic nerve from the thigh of the castrated hybrid chickens is much higher compared to the average thickness of the tissue adipose disposed in the proximity of the sciatic nerve from the thigh of the intact hybrid chickens and that in the thigh of the castrated hybrid chickens we found adipocytes that were arranged among the muscle fibers and around the blood vessels, which could influence the tenderness and juiciness of the capon meat.

At the histological examination we found no differences in the structure of the hepatic and cardiac tissues of the capons, compared to those from the intact hybrid chickens.

On a histopathological preparation from the thigh of an intact hybrid chicken, a cyst of Sarcocystis spp. was discovered, consequence of extensive (traditional) husbandry system and possibly a cause of clinical signs encountered in some individuals in the batch during growth.

Chapter IX, entitled **"General conclusions and recommendations"** summarises the conclusions and recommendations resulting from our research, as follows:

Obtaining a self-sexable hybrid is important because chickens can be sexed from the first day of age, depending on their destination.

The hybrid chicken, due to the heterosis phenomenon, is more vigorous and has better growth compared to the chickens of the breeds it is obtained by crossbreeding.

We sought and obtained a male hybrid chicken that has a light-coloured tegument (yellow) with a commercial appearance, due to the current poultry market trends.

I encountered a particular aspect in the female hybrid chicken that has dark skin, including the limbs, as well as a much faster plumage than the male chickens.

Due to early lotting, cocks can be prepared for claponage at an early age.

We chose the castration of the cocks at the age of 3.5 months because they are quite developed, thus by the castration method chosen by us with the help of the amygdalotome of human use, we were able to approach both testicles on one side without making two sections, which would help the cocks recover faster after the intervention.

The castration of the hybrid at the age of 9 months had very poor results, the testes being large, the size of a pigeon egg and well vascularized, thus the cocks undergoing surgery with the bilateral approach of the testes did not survive the intervention.

We tried the finger enucleation of the testes and obtained good results.

The carcass weight of the castrated hybrid chickens is greater than the intact hybrid chickens.

We have encountered morphological changes so the crests and beards of castrated hybrid chickens are much smaller compared to the intact ones. On the other hand, tail feathers (rectrical) in castrated hybrid chickens are much bigger compared to the intact ones.

Higher brightness values (L* scale) and yellow shades (b* scale) were obtained in the meat of the thigh muscles of castrated hybrid chickens comparing to the meat of the thigh muscles of the intact hybrid chickens.

The yellow shade (b* scale) of the breast muscles had higher values in the meat of castrated hybrid chickens compared to intact ones.

The thigh muscles of castrated hybrid chickens indicated lower a* scale values compared to the intact ones, thus we can mention that the thigh muscles of the castrated hybrid chickens have a lighter colour (light red) than that of intact ones (dark red).

The colour differences in the thigh muscles of castrated hybrid chickens and intact chickens were not influenced by the muscular pH.

The compositional changes in the castrated and intact hybrid chicken meat were more significant in terms of collagen, which has much lower values in the capons.

The protein composition of hybrid cock meat is not influenced by caponisation.

Caponisation intensifies the accumulation of subcutaneous adipose tissue in the breast and thigh.

The caponisation of the self-sexable hybrid did not significantly affect the fat content of the skinless meat.

Another observed aspect in the capons is the accumulation of adipose tissue arranged around the sciatic nerve in the thigh, significantly higher than intact hybrid chickens, as well as the arrangement of more adipocytes among muscle fibers and blood vessels.

By correlating low collagen with the presence of more adipocytes among muscle fibers and around blood vessels, the tenderness of the capon meat could be influenced.

Considering that both the skin and the breast and thigh muscles of the capon have a more intense shade of yellow, this could be correlated with the presence of a higher number of adipocytes in the breast and thigh.

On a histopathological preparation from the thigh muscles of an intact hybrid cock was observed a sarcocystis spp. cyst, consequence of extensive (traditional) husbandry system and possibly a cause of the clinical signs encountered in some individuals in the batch during growth.

In order to be able to approach the testes on one side with the surgical techniques that we have chosen, the cocks must be quite developed, but surgical interventions must be applied before reaching sexual maturity and the appearance of secondary sexual characters.

Considering that the capons and the intact cocks were bred in the same space, hierarchical fights appeared, and the intact cocks showed aggression towards the capons, thus, we recommend raising the capons in homogeneous groups separated by the intact cocks.

In the Romanian household, the breeding of chickens in the traditional husbandry system is still practiced, especially hybrids obtained from mixed breeds, preferably of female sex, thus in order to be able to capitalize the male chickens, we recommend that they should be caponized in order to obtain high-quality meat.

This growth in the traditional system can lead to an easier contact of the birds with various pathogens, as we have demonstrated in our case (the presence of

sarcocystis spp. in meat), so we recommend ensuring the minimum biosecurity measures that can eliminate certain risks.

Chapter X, named ***"Originality and innovative contributions of the thesis"*** captures the most important aspects resulted from the research in this thesis, as follows:

Caponization was achieved on a self-sexable hybrid obtained by crossing mixed breeds of Barred Plymouth Rock chickens as mothers and Red Rhode Island chickens as fathers, well adapted to breeding in traditional Romanian system to obtain a commercially-looking carcass in terms of muscle cladding and tegument colour. Being self-sexable, male hybrid chickens can be lotted from the first day of age, being able to be prepared for an early claponage, and females can be marketed, considering the high demand in Romania of mixed-breed female chicks with good production of both meat and eggs, what lends themself to breeding in the traditional system.

In order to obtain a high quality meat, we chose a long-term growth of the capons, fed with a food as little industrialized as possible and having the possibility of sufficient movement in the outdoor environment.

The research is original in its entirety and it is based on a methodological framework and specific objectives submitted to the study, and the innovative contributions are as follows:

- a study was conducted at the level of the own household that was based on obtaining the self-sexable hybrid, its growth, castration and finishing stage until slaughter, providing us database that allowed us to make assessments and recommendations, as well as correlations, between growth for a long period, breed, feeding, castration age, slaughter age and high quality of capon meat.
- we have revealed the aspects related to the compositional quality (proteins, collagen, fats) and organoleptic characteristics (colour) of the meat of castrated and intact self-sexable hybrid chickens obtained by crossing mixed breeds of Barred Plymouth Rock hens as mothers and Red Rhode Island cocks as fathers.
- we propose as a claponage technique the approach of the testes on one side at the age of 3.5 months, by using the human tonsilectome or enucleation of the testes with the help of our fingers, thus we established recommendations for improve the applied surgical techniques, correlated with the age of the chickens, to reduce the time of the intervention and increase the survival rate of the roosters, as well as reduce their postoperative recovery period.
- we have applied current and modern analysis methods that establish in a more efficient way the various aspects related to the quality of the meat obtained from the claponage of self-sexable hybrid chickens, creating a database for this.
- we have histologically examined in capons and intact hybrid chickens the main parts of the carcass, rich in muscles, specifically the breast and the thigh, following the arrangement of subcutaneous adipocytes, between

muscle fibers, around the blood vessels of the muscles and the sciatic nerve, and as a novelty we measured with the help of a current and modern technique the thicknesses of adipose tissue at different levels, noting that in capons they are much larger than intact hybrid roosters, creating in this sense a database on the influence of the claponage on the thickness of adipose tissue at different levels chosen by us from self-sexable hybrid chicken carcass.

- the study on the self-sexable hybrid chicken reveals that adipocytes were found arranged among the muscle fibers, around blood vessels in the muscles, around the sciatic nerve, which correlated with the low collagen parameter determined by us could influence the tenderness of the meat.
- we have revealed some risks that may bring changes in the meat of self-sexable hybrid chickens (diagnosis of sarcocystosis) raised in a traditional (extensive) husbandry system without respecting some minimum biosecurity measures.

The study provides new data in the specialised literature regarding the effect of claponage on the quality of self-sexable hybrid chicken meat raised in the traditional husbandry system, thus we demonstrated that self-sexable hybrids obtained by crossbreeding mixed breeds of Barred Plymouth Rock hens as mothers and Red Rhode Island cocks as fathers lend themselves to caponisation and the meat obtained after their slaughter has an increased quality.