

Muscle Fibre Typing, Collagen Composition Analysis of Breast and Thigh Meats in Two Breeds of Chicken of Different Growth Performance

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Abstract

The present study was done to evaluate the type of muscle fibre composition in thigh and breast muscle of Red Jungle fowl and Ross. It was also to evaluate the collagen composition in thigh and breast muscle of Red Jungle fowl and Ross. The histological appearance and size of the muscle fibres of Red Jungle fowl and Ross were evaluated. Four wild adult Red Jungle fowl and four market adult Ross chicken were used in this study. Breast muscle (pectoral) and thigh muscle (gastrocnemius) were examined. Three stains were used in this study and there were Myosin ATPase stain, Masson Trichrome stain and Haematoxylin and Eosin stain. Myosin ATPase stain was used to evaluate the muscle fibres type composition, Masson Trichrome stain was used to evaluate the collagen content of the muscle and Haematoxylin and Eosin stain was used to evaluate the histological appearance and size of the muscle fibres. Histologically, the thigh muscle of the Red Jungle fowl has higher proportion of muscle fibres type I to type II than Ross. There were no difference in proportion of muscle fibres type I to type II of breast muscle in Red Jungle fowl and Ross. The thigh and breast muscle of Red Jungle fowl has high collagen content while Ross chicken's thigh and breast muscle has less collagen content. The size of muscle fibre of Red Jungle fowl was small while that of Ross was big.

Keywords: Red Jungle fowl, Ross, myosin ATPase stain, Masson trichrome stain, histology

Introduction

Jungle fowl is considered to be the ancestor of all the domestic chicken (Collias and Saichuae, 1967). Ross is one of the domestic breed of commercial broiler chickens and known for its broad chests, yellow feet, and a ferocious appetite that enables them to grow at rapid paces. Modern broilers are typically fed with high quality formulated diet to increase muscle growth hence increase the body weight.

Different types of system production and feed may attribute to the differences in meat quality between the Red Jungle fowl and the commercial broiler which may be related with the development states of the collagen content and muscle fibres type composition. The muscular structure of the Red Jungle fowl is believed to have different structures in term of collagen content, types of muscle fibre and muscle fibre size microscopically compared to the Ross chicken.

Materials and Methods

Four wild adult Red Jungle fowls and four commercial broiler chicken (Ross) 56 days old were used in this study. Upon euthanasia, the breast muscle (pectoral) and thigh muscle (gastrocnemius) were taken for examination. Three stains were used in this study namely the myosin ATPase stain, Masson's trichrome stain and haematoxylin and eosin (H&E) stain. myosin ATPase stain was used to evaluate the muscle fibres type composition, and helped to differentiate the Type I muscle fibre from Type II. Masson's trichrome stain was used to evaluate the collagen content of the muscle, while the H&E stain was used to evaluate the histological appearance and size of the muscle fibres. For myosin ATPase stain, the muscle sample was snap frozen and then sectioned into 15 μm . The sample was then stained using myosin ATPase. For Masson's trichrome and H&E stain, the sample was first fixed in 10% formalin and then sent for tissue processing. Next, the sample was sectioned using microtome at 3 μm thick and lastly they were stained with Masson's trichrome and H&E stains. For myosin ATPase, type I muscle fibre was stained dark while type II fibre stained light in colour. Ten muscle bundles from one section of each muscle were randomly selected. Mean of the proportion of Type I to Type II muscle fibres were calculated. For Masson's trichrome stain, the muscle fibre stained red while collagen stained green in colour. The distribution of collagen fibers was scored. For H&E, muscle fibre was stained pink in colour. The diameter of six muscle fibers from 5 muscle bundles were chosen randomly and the measurement was taken. Mean of the diameter of one muscle bundle was calculated.

Results and discussion

Histologically, the thigh muscle of the red jungle fowl has higher proportion of muscle fibres type I to Type II than Ross. There were no different in proportion of muscle fibres type I to type II of breast muscle in red jungle fowl and Ross. The proportion of type I to type II muscle fibres of thigh muscle was higher than breast muscle in Red Jungle fowl. This suggests that Red Jungle fowl tend to walk rather than flying.

The thigh and breast muscle of Red Jungle fowl has higher collagen than Ross chicken. This may be due to the differences in muscle fibres size of the chicken. Ross chicken has bigger muscle fibres size than Red Jungle fowl for breast and thigh muscles.

Ross chickens were kept under the intensive system such as close house system or caged system while Red Jungle fowl is free range chicken (Shaik Mohd Amin Babjee, 2009). Under close house system, the activity of the Ross chicken was controlled and they have lesser movement under this system. In addition, their activity was controlled by the lighting system. Red Jungle fowl has better movement under free range system, and thus they have more collagen content in the muscle.

Unlike Red Jungle fowl, Ross chickens do not need to travel to find for the food, and they are normally given high energy feed to improve the meat production. This leads to the increase of the body weight and also the increase of fat deposition.

Ross chicken has better performance than Red Jungle fowl because its performance has been upgraded by crossing with stocks with higher production. The presence of more giant fibres in the muscles of fast growing chicken meat could be considered as one of the side-effects of genetic selection.

References

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