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PHOSPHOLIPID COMPOSITION OF THREE MUSCLES AS RELATED TO THEIR FIBRE COMPOSITION AND TO THEIR OXIDATIVE PATTERN IN THE CHICKEN.

C. RABOT[1], H. REMIGNON[2]., G. GANDEMER[3].

[1] Institut Technique de l'Aviculture, 28 rue du Rocher, 75008 Paris, France.
Institut National de Recherche Agronomique, [2] Station de Recherches Avicoles, 37380 Nouzilly, France and [3] Laboratoire d'Etude des Interactions des Molécules Alimentaires, groupe Lipides-Flaveur, B.P. 1627, 44316 Nantes cedex 03, France.

INTRODUCTION

Lipid composition of Chicken muscles have been widely studied. Most of authors have compared lipid composition of red and white meat (Jantawat and Dawson, 1980; Grey *et al.*, 1983). For this purpose, they analysed lipids of *Pectoralis* and thigh and drumstick muscles. If *Pectoralis* is a pure glycolytic muscle (100% αW fibres), thigh and drumstick are composed of several muscles with various oxidative pattern. Consequently the relationships between metabolic type of fibres and lipid composition are not clearly established in Chicken muscles up to now. This question is of interest because metabolic type of fibres is one of the major factors involved in variability of meat quality traits. Thus, muscles composed of a large proportion of glycolytic fibres (αW) are less sensitive to oxidation and also less tasty and juicy than muscles formed of a majority of oxidative fibres. To control the quality of meat products, we need more knowledge about composition and *post-mortem* changes in the main components of muscles as related to the metabolic type of the fibres. Within muscle components, phospholipids are very interesting to consider because they are largely involved in meat flavour. Thus, they are very sensitive to oxidation causing off-flavour but they are also required for the formation of desirable cooked meat aroma (Gray and Pearson, 1987 Whitfield, 1992).
In this study, we compared phospholipid composition of three muscles with different metabolic patterns. We determinated the relative proportions of fibre types and the metabolic pattern of the 3 muscles. All the parameters were measured in 3, 5, 11 and 55 week old chicken.

MATERIAL AND METHODS

10 to 60 male chickens of X 33 strain (Ricard, 1975) were slaughtered at 3, 5, 11 and 55 weeks of age at a live weight of 285, 670, 1882, 3685 g, respectively. The following muscles were dissected from the carcasses : *Pectoralis major*, *Sartorius* and *Anterior latissimus dorsi* (ALD).. Samples used for histological study were frozen in isopentane cooled by liquid nitrogen. Samples used for enzyme activities determinations and lipid analyses were frozen directly in liquid nitrogen. Samples were stored at -80°C until analyses.
Relative proportions of fibre types were estimated on a cross-sections processed for myofibrillar ATPase technique after incubation at pH 4.20, 4.35 and 10.40 (Guth and Samaha, 1969). Fibres were classified as αW, αR, βR and α' and β' (Ashmore and Doerr, 1971). Percentages of each fibre type were calculated using an original computerised image analysis system (Lefaucheur *et al.*, 1992). The glycolytic and oxidative patterns of the 3 muscles were estimated by the measurement of lactate dehydrogenase (LDH, E.C. 1.1.1.27) and citrate synthase (CS, E.C..13.7) activities (Bass *et al.*, 1969).
Lipids were extracted from 2 to 5 g of meat (Folch *et al.* 1957). Phospholipid content of the muscles was estimated by the phosphorus measurement in total lipid extracts (Bartlett, 1959). After phospholipid purification from total lipid extracts on silica cartridges (Juaneda and Rocquelin, 1985), the relative proportions of the phospholipid classes were determined using the normal phase HPLC method. 200 µg of phospholipids were injected on a column (4.5 x 250 mm, Lichrospher Si 60 5 µm). Phospholipid classes were separated using a solvent gradient and were quantified with a light scattering detector (Leseigneur-Meynier *et al.*, 1989). Results were expressed as % of total phospholipid fraction. Data were subjected to a variance analysis according to the GML procedure of SAS software. The model included the effects of muscle (3 levels) and age (4 levels).

RESULTS AND DISCUSSION.

On the basis of relative proportions of the fibre types, *Pectoralis* is a pure glycolytic muscle (100% αW), *Sartorius* is an intermediate muscle (50% αW, 35% αR, 15% βR) and *ALD* is an pure oxidative muscle (0% αW)(fig. 2). It should be underlined that the oxidative fibres of ALD are α' and β', which have been described only in avian muscles. They differ from αR and βR fibres. One fact of particular interest for this study is their low mitochondria content as compared to the one of typical αR and βR fibres.
LDH or CS activity gives an overall estimation of glycolytic or oxidative pattern of muscles. In this study, the results on the enzyme activities were in a good agreement with the relative proportions of fibre types in the three muscles. Thus, the higher was the αW fibre proportion, the higher was the LDH activity. CS is a mitochondria enzyme belonging to the Kerbs cycle. Its activity is closely related to the mitochondria content of each fibre types. Thus CS activity was very low in *Pectoralis* which contains only αW fibres which are poor in mitochondria. On the contrary, the CS activity is high in *Sartorius* because βR fibres contain a large amount of mitochondria.
In agreement with the published results in various species, the glycolytic muscle (*Pectoralis*) contained less phospholipids than the oxidative ones (*Sartorius* and ALD)(fig. 1). This results is attributed to the higher mitochondria content of oxidative fibres. This hypothesis is strongly supported by the higher proportion of cardiolipin in phospholipid fraction of oxidative muscle such as *Sartorius*(fig. 1). Indeed cardiolipin is a phospholipid mainly located in the inner membrane of mitochondria. In spite of its high proportion of oxidative fibres (more than 95%), ALD exhibited a low phospholipid and cardiolipin contents and a weak CS activity as compared to *Sartorius* (fig. 1 and 2). This result is consistent with the low mitochondria content of α' and β' fibres.

Figure 1 : Changes in the phospholipid content (-x-) and in the cardiolipin (-◊-), phosphatidyl ethanolamine (-□-) and phosphatidyl choline (-Δ-) proportions in *Pectoralis major, Sartorius* and *Anterior latissimus dorsi (ALD)* during chicken development.

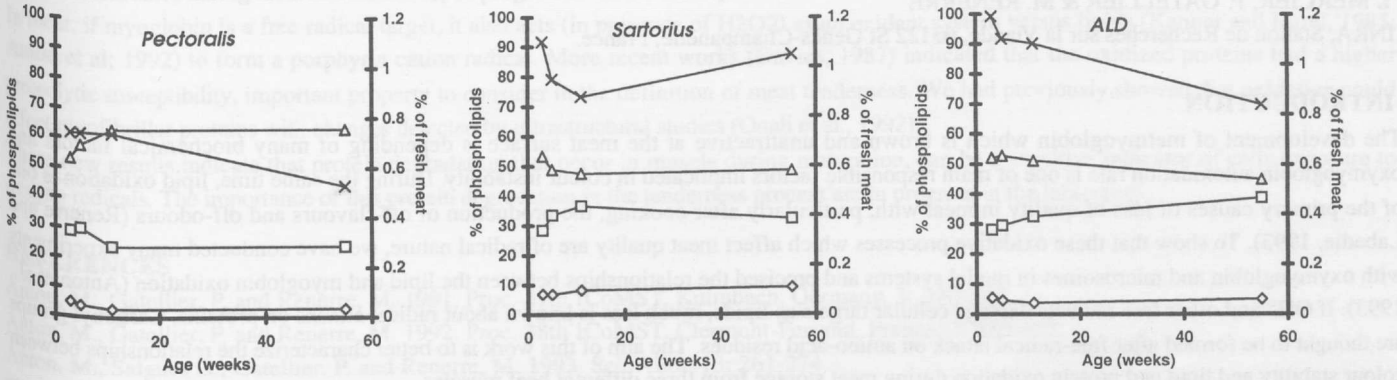

Figure 2 : Changes in the lactate dehydrogenase (-◊-) and citrate synthase (-□-) activities and in the relative proportions of glycolytic (αW : -+-) and oxydative (βR : -x-; β' : -*-) fibres in *Pectoralis major, Sartorius and Anterior latissimus dorsi* during chicken development