AGE RELATED CHANGES IN BREAST POULTRY MEAT COLLAGEN CROSSLINK, HYDROXYLYSYLPYRIDINIUM

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BACKGROUND

Meat texture sensation is dictated by the presence of several factors including the amount of intramuscular fat, water holding capacity and actomyosin complex. However, it is the quality of collagen, which gives the toughness to meat. It has been established that collagen covalent cross-linking mediated by lysyl oxidase enzyme changes with animal advancing age (Bailey and Shimokomaki, 1971, Robins *et al.*, 1973). As animal ages, meat gets tougher due to the changing of the collagen crosslinks. In fact, the immature collagen crosslink, hydroxylysinoketonorleucine (HLKNL) decreases its concentration with the aging of animal whilst the meat gets tougher (Shimokomaki, *et al.*, 1972). HLKNL is replaced by mature crosslink, hydroxylysylpyridinium (HP). Although, chicken is slaughtered at the age which normally would not constitute a texture problem for the consumer, we decided, having breast meat as sampling, to investigate the changes of HP during poultry (hen) advancing age and to relate it to the collagen solubility and to meat texture.

OBJECTIVES

To study the changes of collagen crosslink hydroxylysylpyridinium with poultry aging and to relate it with collagen solubility and texture of hens breast meat

METHODS

Samples: *Pectoralis major m.* from laying hen of different ages: 20, 40, 90, 180, 365 and 540 days was analyzed for collagen contents, HP concentration, collagen solubility and texture.
Collagen determination: It was based on Woessner technique (1961)
Analysis of HP: 50 mg of freeze-dried samples were hydrolyzed in HCl 6N and the non-crosslinking aminoacids were initially separated on CF1 cellulose column (Skinner, 1982). HP was analyzed quantitatively on a Shimatzu HPLC model RF-535 with a Supelco reverse phase column (Eyre, 1987). The location of HP was confirmed with authentic HP standard, a gift from Professor Bailey, University of Bristol, UK.
Collagen solubility: This solubility was measured in Ringer solution at 77°C for 65 minutes and soluble collagen was quantified in the supernate (Hill, 1966).
Meat texture: Texture was measured in 15 samples from each bird by Warner Bratzler shear force using SMS Texture Analyzer, TAXT2i model (Young *et al.*, 1994).
Statistical analysis: Otherwise mentioned, all measurements were carried out in triplicate and results were subjected to the Statistics for Windows 5.0 (Statsoft, 1995) for analysis of variance and Tukey test.

RESULTS AND DISCUSSIONS

Table 1 presents the results obtained for collagen contents (% wet basis), HP concentration (mol/mol of collagen), Collagen solubility (%) and shear force (N) in hens' breast meat samples taken from various ages (20, 42, 90, 180, 365 and 540 days after hatching).
Collagen contents: From Table 1, it can be observed two distinct phases. First, a rapid increase in collagen concentration up to app 100 days (range from 0.448 to 0.540g%) and remains fairly constant throughout advancing in age (range from 0.540 to 0.568 g%) Similar results were obtained by Nakamura *et al* (1974) and in pigs by Nakano *et al* (1991)
Cross link concentration: There is a sharp increase in HP concentration from 20 to 40 days after hatching (range from 0.0091 to 0.0409 mol/mol of collagen). Subsequently, a steady increase is observed from 200 days onwards (range from 0.040 to 0.1032 mol/mol of collagen).
Collagen solubility: As birds age, meat collagen solubility measured in Ringer solution decreases inversely in relation to HP concentration. There is a sharp decrease in solubility from 20 days to 40 days after hatching, (range from 54.73 to 25.70%, respectively). A gradual decrease is observed as the bird maturity advances (range from 29.0 to 6.60%) These results suggest there is a straight relationship between HP concentration and collagen solubility property.
Meat texture: The shear force indicates a sharp increase in texture from age 20 to app. 100 days after hatching (range from 16.7 to 35.0 N, respectively). There is a gradual increase as the birds advance in age (range from 41.9 to 60.3 N at 540 days after hatching). In contrast to the other results observed in ovine (Young, *et al.*, 1994), it seems that in poultry, meat gets tougher with the increase concentration of HP as also recently observed in bovine (Bosselmann, *et al.*, 1995).

Our results support the previous theory that collagen crosslinking is important factor for the mechanism of regulating the rate of *in vivo* tissues catabolism. Up to 100 days after hatching, there is a noticeable increase in collagen synthesis. After this hatching period of time, as the HP is introduced into collagen fibrils it imparts resistance to degradation by collagenase as measured by the rate of diminution of collagen solubility. While the rate of collagen synthesis becomes proportionally constant throughout poultry advance in age the HP concentration keeps being formed (Table 1) which brings about the slow down of collagen turnover.

CONCLUSIONS

The toughness of breast chicken meat is only observed after app. 300 days after hatching. Since there is no increase in collagen content after this age the increase in meat texture seems to be related to collagen crosslinking corroborated by the diminution of collagen solubility.

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Table 1: Collagen content (g%), Hydroxylysylpyridinoliniun concentration (mol/mol of collagen), Collagen solubility (%), Shear force (N) in breast meat *P. major m.* in relation to hens advancing in age (days)

Age (days)	*Collagen content* (g%)*	*Hydroxylysylpyridinoliniun concentration* (mol/mol of collagen)*	*Soluble collagen content* (%)*	*Shear force• (N)*
20	$0.448^{a} \pm 0.027$	$0.0091^{a} \pm 0.0017$	$54.73^{a} \pm 3.24$	$16.71^{a} \pm 1.20$
42	$0.520^{b} \pm 0.063$	$0.0409^{b} \pm 0.0100$	$25.72^{b} \pm 1.16$	$17.98^{a} \pm 2.65$
90	$0.543^{b} \pm 0.085$	$0.0390^{b} \pm 0.0124$	$29.08^{b} \pm 1.65$	$35.03^{b} \pm 2.79$
180	$0.537^{b} \pm 0.037$	$0.0449^{b} \pm 0.0156$	$25.29^{b} \pm 1.27$	$41.92^{b} \pm 6.03$
365	$0.550^{b} \pm 0.019$	$0.0732^{b, c} \pm 0.0253$	$12.04^{c} \pm 1.39$	$52.18^{c} \pm 3.96$
540	$0.568^{b} \pm 0.057$	$0.1032^{c} \pm 0.0245$	$6.65^{d} \pm 1.09$	$60.36^{d} \pm 2.78$

Values are expressed in wet basis (Medium value ± Standard Device).
* $n \geq 4$
• $n \geq 15$
$^{a, b, c, d, e}$ Different characters in the same column show a significative difference among treatments ($p < 0.05$).