UP-TO-DATE KNOWLEDGE ON THE NUTRITIONAL COMPOSITION OF POULTRY MEAT

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Background

Poultry, especially chicken broilers and turkey, is one of the most widely consumed muscle foods in the world. Poultry meat is an important source of dietary energy and nutrients, providing high quality protein, essential fatty acids, vitamins, and highly bio-available minerals (D'Amicis and Turrini, 2002). Updated information concerning nutrient contents of poultry muscles is needed for the establishment of the nutritional value of both fresh and processed products, including ready-to-eat items. The amount, type and proportion of fatty acids as well as cholesterol in muscles are of particular health concern. These data are necessary for poultry processors in developing strategies to manufacture healthy products with desirable nutritional composition. Based on the wealth of literature on poultry muscle quality, one would assume that the nutritional value of poultry meat has been well established. In reality, this is a false assumption, because the results are in some cases based on whole poultry carcasses, and in other cases on specific muscles, and many times the data are incomplete or out-of-date.

Objectives

The aim of the paper is to present the nutritional value of poultry meat on the basis of the most up-to-date literature available and to point out the areas where more research is needed to advance out understanding of the subject.

Results and discussion

Chemical composition

The chemical composition of poultry breast (B) and thigh/leg (T/L) muscles was recently reviewed by Lesiow (2004) and is presented in Table 1. The richest in protein are B muscle of turkeys, broilers, geese and ducks, followed by T/L muscles of ducks, geese, turkeys and broilers. The fat content of B muscle, in an ascending order, is: turkey female, Pekin and Muscovy ducks, hens, broilers, turkey males, Mule ducks and geese, and for T/L muscle, the order is: Pekin, Mule and Muscovy ducks, hens, turkey, geese and broilers. B muscle contains more protein (0.4 to 3.8%) and less fat (0.29 to 5.07%) than T/L muscles. Moisture content of Pekin and Muscovy ducks is greater than of other kinds of poultry. Broilers, hens and Mule ducks have intermediate moisture content, while turkey and geese have substantially lower values. The B muscle of broiler, Pekin duck and goose has a higher percentage of moisture than their T/L muscles. The differences in chemical composition between males and females are also well documented (Lesiów, 2004, Table 1). Male broiler muscles have a higher moisture and ash content than do females. A lower moisture content and higher fat content are observed in turkey and Mule duck male B muscle when compared with females. A reverse trend, i.e., higher moisture and lower lipid contents, holds true for male and female B muscle of Pekin ducks. Muscovy duck and goose male B muscle has a higher fat content than the female counterpart. Turkey and Pekin duck male T muscle contains less fat than female T muscle. There is a lack of literature report on the chemical composition of Mule duck and goose T/L muscles.

The content of collagen influences nutritional and dietetic values of meat. Poultry B muscle contains less collagen (except for Pekin ducks) than T muscle (Table 1). As a protein of lower nutritive value, collagen is the lowest in turkey and goose and higher in broiler and Pekin duck muscles. Information is scarce about the collagen content in Mule and Muscovy duck muscles, and data available for geese were published in 1983-1984 (Bielińska et. al., 1984). The collagen content is sex dependent. Male broiler B and T muscles and turkey and goose T muscle contain more collagen than female muscles. The reverse is true for turkey and goose female B muscle.

Vitamins and Minerals

Broiler meat is an important source of niacin (PP) and vitamin B6, and duck and goose meat are rich in thiamine (B1) and riboflavin (B2). Broiler and turkey T/L muscles contain more vitamin B2 and less vitamins PP and B6 than B muscle. However, literature about vitamins in poultry meat dates back over 20 years and the content of vitamins in duck and geese is not presented for particular muscles but instead for the whole flesh (total amount of musculature in a carcass) (Hamm and Ang, 1984; Posati, 1979).

Mineral content of broiler and turkey B and T/L muscles has been reviewed (Lesiow, 2004). However, data for duck and goose meat are typically presented in relation to whole carcass flesh and are very often incomplete. Broiler and turkey T muscles are richer than B muscle in Fe (10.70 vs. 6.81 μg/g, and 11.87 vs. 5.01 μg/g) and Zn (15.27 vs. 6.65 μg/g, and 26.03 vs. 9.08 μg/g). This is due to the higher myoglobin and haemoglobin content and greater metabolic activity associated with the red muscle fibres. Turkey and broiler muscles are generally also rich in phosphorus and potassium. The mineral content of broiler B and L muscles is identical between sexes. There is no information about the possible influence of sex on the mineral content of the muscles of other poultry species. There is an interesting discrepancy (from 7.1% to 105%) in the mineral content of duck and goose flesh presented by Kunachowicz et. al. (2002) and Posati (1979), respectively.

Cholesterol and FFA

From the health and nutrition standpoint, it is important not to simply reduce the fatness and cholesterol content of carcasses but rather, to improve the FFA make-up, such as the proportion of n-3 fatty acids, in poultry muscles. The modern dietetics recommend the decrease of polyunsaturated PUFA n-6/n-3 ratio in human diet and to separately evaluate the content of linolenic acid, arachidonic acid, eicosapentaenoic acid (EPA), and docosahexaenoic acid (DHA) in foods (Okuyama et al., 1997).

The cholesterol content of poultry B muscle, in an ascending order, is as follows: broilers, hens and turkeys, Muscovy ducks, geese, Pekin and Mule ducks. The corresponding cholesterol content of broiler, turkey and goose T/L muscles is substantially less than in hens (Lesiów, 2004). The cholesterol content of B muscle is lower in broilers (by 56.5%) and turkeys (by 44.4-50.0%) than in their corresponding T/L muscles. On the contrary, the cholesterol level in goose B muscle is higher (by 20.5%) than in its T muscle. No data can be found on the cholesterol content of duck T/L muscles. B muscles of male turkey, goose and Mule duck show higher cholesterol content than their female counterparts.

The principal fatty acids in poultry muscles are oleic, palmitic and linoleic (Lesiów, 2004). In broiler, hen, Pekin and Muscovy ducks as well as goose, the lipids of B muscle are comprised of more saturated fatty acids (SFA), PUFA and less monounsaturated fatty acids (MUFA) than T/L muscle lipids (Table 1). Komprda et al. (2001) observed no differences in FFA composition between B and T muscles of turkey. However, the same research group reported later that turkey B muscle contained lower amounts of SFA, PUFA but more MUFA than T muscle (contrary to broilers) (Komprda et al., 2002). The PUFA n-6/n-3 ratio of broiler and turkey B muscle is lower in comparison with T muscle, whereas in hens, Muscovy ducks and geese the ratio is slightly higher in B than in T/L muscles. Pekin and Muscovy duck B muscle contains more SFA than other species of poultry (Lesiów, 2004). The percentage of MUFA is generally higher in goose B and T muscles and in duck T muscle compared to muscles from other poultry species. The most favourable ratio of PUFA n-6/n-3 is within broiler and turkey muscles, and then within hens, ducks and geese. Literature data within the duck species is difficult to compare due to variations in the age of the birds used in different studies as well as different production conditions employed. Turkey male B muscle has a higher MUFA content but lower SFA and PUFA, and turkey male T muscle has a higher SFA content but lower PUFA content than turkey female corresponding muscles. Goose male B muscle possesses a more favourable FFA profile compared to female B muscle as evidenced by the higher percentage of MUFA and lower level of SFA (Batura et. al., 1999).

Conclusions

It should be pointed out that the chemical composition and thus, the nutritional value of poultry meat is influenced by many production factors, such as diet (nutritional composition of the feed), the conditions in which the birds are grown, and the specific strains. For example, our previous studies (Xiong et al., 1993a,b) showed that broiler meat varied slightly in basic composition (protein, lipid, mineral and water) between

strain crosses. Therefore, evaluations of nutritional value of different poultry species should be done in the context of the ever-changing breeding technology that is likely to underscore strain-dependent variations in the meat composition. Results published by individual research laboratories are generally dealing with the whole poultry carcasses (e.g., mineral content in hen, duck and geese) or with specific muscles, and in some cases, the data are not complete (e.g., cholesterol and FFA content for different duck species) or up-to-date (e.g., vitamin content in turkey, duck and goose thigh/leg muscles). Further research is needed to fill in the gaps in the knowledge of the nutritional value of poultry muscles.

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Table 1. Chemical composition (%), relative collagen content (%), and cholesterol concentration (mg/100g) in poultry breast (B) and thigh/leg (T/L) muscles (Lesiów, 2004).

	Moisture		Protein		Fat		Collagen		Cholesterol	
	B	T/L	B	T/L	B	T/L	B	T	B	T/L
Broilers	74.36	73.21	22.80	19.14	1.58	6.65	0.54	1.05	47.42	74.20
Hens	73.21	74.04	-	-	1.51	4.49	-	-	50.07	100.61
Turkey (M)	72.74[22*]	72.24	23.36	19.54	1.63	4.84	0.39	0.57	50.85[20]	73.45
Turkey (F)	73.51[15]	72.91	23.29	19.52	1.25	6.28	0.43[16]	0.48	48.20[14]	72.30
Ducks:										
Pekin	76.82[7]	75.80	21.20	20.90	1.31	2.00	1.15	0.70	111.06	-
Muscovy	76.43[12]	76.06	20.89	20.31	1.43	3.43	-	-	67.00	-
Mule	74.55[12]	74.50	21.78	21.40	2.41	2.70	-	-	105.0	-
Geese	72.36[17]	71.55	22.48	20.38	3.11	6.51	0.40	0.60	84.35	70.00

*age (weeks)

Table 2. Proportions of FFA (%) in poultry breast (B) and thigh/leg (T/L) muscles (Lesiów, 2004).

	SFA		MUFA		PUFA		n-6/n-3	
	B	T/L	B	T/L	B	T/L	B	T/L
Broilers	33.12	31.07	36.95	41.08	28.41	26.41	5.35	6.33
Hens	34.01	31.79	35.13	43.40	25.57	22.38	8.01	7.69
Turkey (M)	30.10	32.00	36.60	32.70	27.10	29.70	5.16	5.46
Turkey (F)	32.10	29.10	32.10	32.60	29.20	32.10	4.62	5.55
Ducks:								
Pekin	45.46[9]	30.99	34.61	51.11	17.03	12.44	-	12.23
Muscovy	38.70[10.5]	34.75	30.80	43.92	30.50	18.08	22.46[12]	19.55
Mule	-	29.07[14]	-	46.27	-	19.87	-	24.81
Geese	27.99[15]	27.35	62.80	65.00	9.10	7.58	112.7	107.3