Nutrition for Functionality of Poultry Meat and Egg

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Abstract

Functional foods are foods enriched with single ingredients, which influence 1 or more functions of the consumer in a favorable way, exceeding the effects of the normal adequate nutrition. Consumers can expect health from these products. To production of functional poultry meat and egg are attached importance to results related to omega-3 fatty acids, antioxidants, selenium and phenolic compounds' supplementation to poultry diets. It is estimated that their productions will be increased in the future although the food market share of functionel poultry meat and egg is small. In this article, nutrition applications related to functional poultry meat and egg and the physiological, economic and legal aspects of these animal products will be mentioned.

Keywords: Antioxidants, broiler, egg, functionality, laying hens, meat, omega-3

INTRODUCTION

Despite the rapidly increasing world population, chronic diseases such as cardiovascular diseases, cancer, diabetes, obesity and high treatment costs of these diseases, awareness development of the relationship between consumers' health and nutrition, changes in food marketing have led to the emergence of functional foods (Kanberoglu & Meral, 2013). Functional foods described as foods of the today and future are addressed under the healthy living programs and levels of production and consumption is increasing rapidly throughout the world. According to the functional foods commissions' definition of European Union, the functional foods are similar to the traditional foods in point of basic nutritional impact and must be effective in the improvement of human health as both general and physical status and in the preventing of the occurence of diseases (Zduńczyk & Jankowski, 2013). According to 2008 data of functional food market, United States (US) had the largest share while followed by the European Union (EU) countries and Japan. Functional food market in Europea (Germany, France, UK, Netherlands) is being exceeded $ 2 billion and less than 1 % of the total food market. On the other hand, this rate is expected to reach 25 % in the future 10 years. Data for 2015 years showed that the functional food market in Turkey has a volume of 2.2 million dollars, Turkey funtional food market is appeared to be in its infancy according to the functional food market in Japan and EU (Kanberoglu & Meral, 2013).

In recent years, the most commonly studied anmal protein sources on the scope of functional animal food production in Turkey is reported that poultry meat and eggs (Zduńczyk & Jankowski, 2013).

The enrichment of poultry meat and egg by the beneficial substances (omega-3 polyunsaturated fatty acids (PUFAs), conjugated linoleic acid, selenium and antioxidants) for human health leads to an increase at the consumption as the funtional food sources by humans (Grashorn, 2007).

Nutrition Applications for Functionality of Poultry Products

The functionality for poultry products can be gained during the production of raw materials (meat and eggs) and during processing of meat. To design of functional poultry products, functional ingredients such as omega-3 PUFAs, conjugated linoleic acid, vitamin E, selenium, plant extracts and polyphenolic compounds are supplemented to the poultry diets. Direct fortification is obtained by the use of functional feed additives such as plant proteins, whey, fibre, herbs, prebiotics, probiotics, minerals and vitamins during meat processing (Zduńczyk & Jankowski, 2013).

Omega-3 PUFAs

The omega-3 PUFA level and the ration of omega-6 to omega-3 fatty acids in human diets had an important effect on it's metabolism. Daily intake of omega-3 PUFAs is recommended as 450-500 mg for human health (Givens, 2009). It is reported that the high intake of omega-6 PUFAs in relation to omega-3 PUFAs leads pathological changes and several chronic diseases in humans (Grashorn, 2007). The optimal omega-6/omega-3 PUFAs ratio to remove the negative effects of high intake of omega-6 PUFAs on human health should be 1:1 or 2:1 and not exceeded 4:1 (Simopoulos, 2011). To enrich of poultry meat and egg yolks, feedstuffs rich in omega-3 PUFAs such as fish meal, fish oil, flaxseed and flaxseed oil were supplemented to broiler' and laying hens' diets (Zduńczyk & Jankowski, 2013). As a result of this, omega-3 PUFAs are obtained from poultry meat and eggs as animal protein sources. Rahimi et al. (2011) reported that the supplementation of flaxseed and canola seed to broiler diets increased the omega-3 PUFAs levels and decreased the ratio of omega-6 to omega-3 PUFAs of its meat. The feeding the diet containing 3.5 % fish oil for 4 weeks increased four times the omega-3 PUFAs level in egg yolk compared to the control group (Van Elswyk, 1997). At a previous study, the addition of fish oil alone or in combination with flaxseed oil to diets leads to 1.25-1.52 of the ratio of omega-6 to omega-3 in eggs, on the other hand, this ratio is obtained as 25.75 when the diet contained sunflower oil (Farrell, 1998). Especially, the use of fish oil in the poultry diet for enrichment causes off-flavors due to fish-typical substances deposited in broiler meat and laying hens' eggs. The use of flaxseed oil and echium oil in poultry diet is prefered instead of fish oil due to its above mentioned negative effects (Zduńczyk & Jankowski, 2013) because PUFAs found in these oils were effectively transferred from diet into meat and egg (Kitessa & Young, 2009; Sosin-Bzducha & Krawczyk, 2012).

Conjugated Linoleic Acid

Conjugated linoleic acid (CLA) and omega-3 PUFAs have similar benefits on the human health although egg yolk and meat of poultry contain small amounts of CLA (0.6- 0.9 mg/g fat) (Zduńczyk & Jankowski, 2013).

A previous study showed that CLA supplementation to broiler diets (2 and 4 %) increased the CLA content of breast and thigh meat by 46 and 38 times compared to the control group, on the other hand, did not affect their fatty acid contents (Sirri et al. 2003). It is reported that breast and thigh meat only meet 3.5 and 9.0 % of human recommended daily intake for CLA in this research, respectively. Enrichment of CLA in tissue is not effective as the enrichment of omega-3 PUFAs as.

Antioxidants

The enrichment of poultry meat or egg with omega-3 PUFAs increased lipid oxidation. The important antioxidants used to prevent lipid oxidation in poultry products are α-tocopherol, selenium, α-lipoic acid and plant extracts etc.

Kim *et al.* (2006) indicated that increasing the level of dietary α-tocopherol (200 or 400 IU) enhanced α-tocopherol concentration and decreased lipid oxidation of of breast and thigh meat of broilers.

Jang *et al.* (2010) found that supplementing poultry diet with quercetin at 200 mg/kg diet substantially decreased TBARS of broiler meat.

Taulescu *et al.* (2011) showed that the addition of selenium (0.3 mg/kg sodium selenite) and vitamin E (200 mg/kg α-tocopherol acetate) to broiler diets enriched with omega-3 PUFAs (15 % flaxseed) significantly decreased the lipid oxidation of meat during storage.

The most effective dose of dietary oregano essential oil supplementation to reduce lipid oxidation was found at 100 mg/kg level in chicken meat (Velasco and Williams, 2011).

Zduńczyk *et al.* (2011) found that the supplementation of the different levels of selenium (0.15 or 50 mg/kg) and vitamin E (40 to 200 mg/kg) increased contents of both anti-oxidants in their breast muscle, i.e. in the case of selenium – from 0.05 mg/kg to 0.08 mg/kg, and in the case of vitamin E – from 3.12 to as much as 14.97 mg/kg and demonstrated to contain a relatively high content of PUFA n-3 (4.84–5.25%).

Sohaib *et al.* (2013) pointed out that dietary supplementation of α-lipoic acid at 150 mg/kg with α-tocopherol acetate at 200 mg/kg increased the antioxidant potential and lipid stability of broiler leg meat and meat products.

Kim *et al.* (2014) also showed that α-tocopherol alone or in combination with red ginseng enhanced the DPPH radical scavenging capacity of broiler meat.

Sohaib *et al.* (2015) reported that supplementation of quercetin with α-tocopherol to broiler diets (especially 300 mg/kg quercetin+300 mg/kg α-tocopherol) improved antioxidant capacity, stability of lipids and fatty acid composition of breast meat of broilers.

Status of Functional Food in Europea and Turkey

The regulations govering the market introduction of foods having nutritional and heath claims are laid down by Regulation (EC) No. 1924/2006 of the European Parliament and of the Council of 20.12.2006 on nutrition and health claim made on food. The results of research studies have been transferred to practical applications. One of these applications is the production of Columbus® eggs enriched with omega-3 PUFAs and vitamin E that are produced over 50 million per year in Europea (Siro et al. 2010).

It is reported that the main sources of omega-3 PUFAs are raw and processed meat that constitutes 40 % share of poultry meat (Zduńczyk & Jankowski, 2013). According to Givens (2009), the main sources of EPA and DHA are eggs (54.3 mg) and poultry meat (74.8 mg). On the other hand, factors restricting the modification of omega-3 PUFAs content of poultry are deterioration of meat's sensory attributes, higher production costs, the alternative methods of modifying the nutritional value of meat and legal restrictions applicable to the food industry (Zduńczyk & Jankowski, 2013). In line with the provisions of Regulation (EC) No. 1924/2006, for meat to be labelled as a source of omega-3 PUFAs, it has to contain 0.3 g α-linoleic acid/100 g of the product (3 mg/g).

Factors Restricting the Modification of Poultry Meat and Egg and Their Legal Aspects

At the applications for functionality of poultry meat and egg, there are various methods and legal restrictions as well as their high production cost. Being new of functionality concept and the lack of regulation on the issue of functional foods lead to various problems during their market introduction in the world and Turkey despite a rapid increase in the research and investment made on functional foods. Functional foods at different categories and under license are presented to the market and paid attention to have misleading information in labeling due to the absence of regulations for functional food production in the US and EU countries. In Turkey, the market share of functional poultry products (egg rich in DHA, Se or omega-3 PUFAs) is quitely low although there is not it legal size. Functional foods in Turkey are produced within Turkish Food Codex and Food Production with the approval of the Ministry of Food, Agriculture and Animal and the studies are carried out in parallel with the EU harmonization process. In particular, functional poultry products before their introduction to consumption should be determined by clinical tests that contained the protection of functional foods from which diseases and should be written on the product's label.

CONCLUSION

Being conscious for health of consurmers increases day by day the interest for functional poultry meat and egg. Morever, the importance of these animal products is widely understand. The number and variety of these commercial products are increased recently. Poultry meat and egg can effectively be enriched with omega-3 PUFAs, α-tocopherol and Se to meet the requirements for functional foods, whereas enrichment with CLA is less effective. Functional foods will be popular in the future years with numerous practical applications although the share in the functional foods market is low due to their limited studies and high price.

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