



ISSN (E): 2277- 7695

ISSN (P): 2349-8242

NAAS Rating: 5.03

TPI 2019; 8(4): 829-831

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www.thepharmajournal.com

Received: 13-02-2019

Accepted: 15-03-2019

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Designer eggs and poultry meat as functional foods – An overview

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Abstract

Poultry eggs and meat are a good source of essential nutrients. Designer food refers to the food that is designed to have some health benefits other than its traditional nutritional value. In this review an attempt has been made to focus on the different methods of improving the nutritional quality of poultry eggs and meat by enhancing levels of omega-3 fatty acids, anti oxidants, carotenoids, immunomodulators and lowering of cholesterol content.

Keywords: Designer egg, designer meat, n-3 fatty acids enriched designer egg, anti oxidants in eggs

Introduction

Indian poultry industry is expanding at a rapid rate to meet the increasing demand of the consumers for egg and poultry meat. The poultry eggs and meat are nutrient rich foods which are regarded as less expensive source of high quality protein with several other essential nutrients.

In the recent years people have become more conscious of the relation between food and their health. In this regard, they started to show more interest in the foodstuffs they consume, and so also in the quality of poultry meat and eggs. Primarily, the main concern of consumers is that the food they consume is safe and healthy, i.e. free of substances which could directly affect their health (microorganisms, mycotoxins, pesticides, antibiotics, etc.). Secondly, consumers have shown special interest in poultry products which have reduced content of substances which can pose risk to human health which in turn developed production of poultry meat and eggs with reduced fat and cholesterol content. In the third phase, consumers expect to derive additional benefit by enriching with substances beneficial for their health and poultry meat and eggs have huge potential in this aspect.

Designer food refers to the food that is designed to have some health benefits other than its traditional nutritional value. 'Designer food', 'functional food' and 'fortified food' are synonyms. Many authors define functional food as food containing active components which exert positive effect on physiological processes in the individual and have beneficial effects on human health because they reduce the risk of incidence of various diseases.

No other single food of animal origin is eaten by so many people all over the world compared with the egg and none is served in such a variety of ways. Therefore, the ability of the egg to be used as a functional food has been widely investigated because the egg composition can be partly modified by changing the poultry feed.

Eggs can be designed through dietary approaches either by supplementation of specific nutrients, or certain herbs or specific drugs that have functional and therapeutic properties. In case of poultry, there are two types of value addition of products:

- Pre-slaughter value addition i.e. value addition before the product is produced. Products like, designer / organic / functional eggs and meat fall under this category.
- Post-slaughter value addition i.e. value addition after the product is produced.

These types of value addition can be done mostly by combination of manage mental and nutritional manipulations.

Ways to produce designer eggs

- Inducing metabolic changes in the hen that can result in synthesis of compounds that essentially end up in the egg.
- Change the characteristics of membrane transport to facilitate movement of compounds into the egg.

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- Manipulate the diet of the hen such that the level of the desired compounds increase in the egg

Points to be considered before enriching eggs

- Efficiency of nutrient transfer from feed to the egg.
- Availability of commercial sources of effective feed forms of the nutrient
- Possible toxic effects of nutrients for the laying hens (Ex: Vitamin A and D are toxic for chickens at high levels)
- Amount of nutrient delivered with an egg in comparison with Recommended Dietary

Allowance (RDA).

- Established health promoting properties of nutrients and their shortage in modern diet.
- Possible interactions with assimilation of other nutrients from the egg.
- Stability during cooking.

Dietary manipulations to produce designer eggs

Dietary manipulation is the major step in producing the preslaughter value added poultry products.

Omega-3 Fatty acids enrichment

The total fat content in the egg yolk cannot be altered but its fatty acid composition can be altered, by changing the type of oil used in the hens' diet. Omega-3 fatty acids are a group of polyunsaturated fatty acids (PUFA) also known as n-3 fatty acids. Majority of birds and animals including human beings cannot synthesize these n-3 fatty acids, hence they are dietary essential. Sources of Omega-3 fatty acids are fish oil, linseed/ flaxseed & oils, rapeseed / canola & oils, safflower oil, soyabean oil and marine algae.

Unfortunately, the foodstuffs rich in these n-3 fatty acids namely linseed and fish oils have undesirable flavor and consistency, hence not relished commonly by human beings. They can be made acceptable by incorporating these beneficial n-3 fatty acids into eggs.

Clinical Significance of Omega-3 Fatty acids

Research on the various health benefits of dietary omega-3 fatty acids has shown that these fatty acids reduce plasma triglycerides, blood pressure, platelet aggregation, thrombosis and atherosclerosis particularly in diabetics, tumor growth, skin disease, suppresses inflammatory process and enhance immunity. In designer eggs the n-6 / n-3 PUFA ratio is decreased to about 1.5 from as much as 20 in regular eggs. Without any change in the sensory quality of the egg this change in designer eggs will supply about 50% of the daily requirement of n-3 PUFA ratio to the consumer. Since n-3 fatty acid enriched eggs will undergo rancidity quickly, it is necessary to prevent the rancidity of the designer egg yolk lipids, by incorporating anti-oxidants in the hens' diet and extend the shelf life of the product.

Anti Oxidants in eggs and meat

Egg is a rich source of natural antioxidants like vitamin-E, selenium, carotenoid pigments, flavonoid compounds, lecithin and phospholipids. These compounds protect the fat-soluble vitamins and other yolk lipids from oxidative rancidity. However, these levels are not sufficient to protect the designer eggs rich in n-3 PUFA. Hence it is essential to increase the anti-oxidant levels in the designer eggs. The designer egg and meat, not only contain high levels of the above antioxidants; but also rich in herbal active principles like, Allicin, Betaine,

Eugenol, Lumiflavin, Lutein, Sulforaphane, Taurine Eugenol, Lumichrome, Lycopene, Curcumin, Carnosine, Quercetin, depending upon antioxidants of herbal origin used in hens' diet. Supplementation of these anti-oxidants in hens' diet will increase their levels in the egg and meat.

The advantages of enrichment of the egg and meat with anti oxidants include:

1. Decreased susceptibility to lipid peroxidation
2. Prevention of fishy taint to the product
3. Designer foods could be a good source of antioxidants in human diet
4. Prevents destruction of fat-soluble vitamins and natural fat-soluble pigments

For designer egg/meat production, vitamin E and organic selenium are added as anti-oxidants at levels of 200-400 mg/kg and 0.1-0.3 ppm respectively. Besides these, other anti-oxidants such as chemicals and herbs may be added, to prevent oxidative rancidity.

Lowering Cholesterol Content

A large egg contains about 200 mg of cholesterol and chicken meat contains about 60 mg per 100 g. Research towards lowering egg cholesterol has been concentrated mostly on dietary and pharmacological interventions. Chromium, copper, nicotinic acid, statins, garlic, basil (tulsi), plant sterols, n-3 PUFA supplementation to chicken feed will reduce the yolk and carcass cholesterol levels significantly.

Enrichment with Carotenoids

Carotenoids occur naturally in egg yolk in varied amounts depending on hen's feed. Deep yellow or orange colour yolks and yellow skin broilers are preferred over pale yolks and skin. Feed fortification with natural sources such as Marigold, Alfalfa extracts are sources of lutein. Other sources such as Corn and Red pepper provide zeaxanthin and capsanthin respectively. Lycopene is a hydrocarbon carotenoid reported to have strong antioxidant properties effective in reducing the risk of prostate carcinoma. Although lycopene is not usually found in eggs, lycopene enrichment can be achieved via feed fortification with tomato powder and lycopene could reduce yolk lipid peroxidation. Besides providing attractive colour, they act as anti-oxidants and anti-carcinogenic agents. Some of the pigments have vitamin A activity. For example, the lutein which safeguards the retina.

Enrichment with Immunomodulators

Chicken egg is abundant in antibodies like "IgY" which is cheaper and better than mammalian immunoglobulin "IgG". This "IgY" can be used to treat human rotavirus, E.coli, Streptococcus, Pseudomonas, Staphylococcus and Salmonella infections.

The IgY level in the egg can be increased by dietary manipulations. The functional feed rich in omega - 3 fatty acids and anti-oxidants itself will increase the IgY level in the egg. Herbal supplementation will further boost the IgY level in the egg. Among the herbs, Basil leaves (Tulasi) is having the highest ability to boost the IgY level in the egg. Other herbs like Rosemary, Turmeric, Garlic, Fenugreek, Spirulina, Aswagandha, Arogyapacha etc also possess immunomodulating properties.

Conclusion

Poultry eggs and meat are a good source of essential nutrients. The egg is considered as nature's most complete food

containing high quality proteins, a 2:1 ratio of unsaturated fats to saturated fat, an excellent source of iron, phosphorus and other minerals and all vitamins with the exception of vitamin C. Although the best source of all the vital nutrients, high cholesterol content is the major constraint for egg consumers. The development of nutrient enriched value added poultry eggs and meat greatly increased the context of functional foods for human health. By manipulating the diet of chicken with nutritional interventions like supplementation of chromium, copper, herbs, probiotics, n-3 fatty acids, antioxidants etc. value added and health promoting chicken egg, meat and their products can be made available to the consumers. The designing must take into consideration the production facilities, available materials, technical know-how, economic resources of the producers and environmental impacts with welfare issue.

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