



Designer Eggs: From Conventional Eggs to Functional Foods

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Abstract

Diet acting as vital role in maintaining health. Among the different products delivering essential nutrients to the body, an egg has perhaps a special place, being a rich and balanced source of essential amino and fatty acids as well some minerals and vitamins. In spite of all positives, it is being often blamed as high cholesterol food because of its lipid profile in the yolk. This demand has led to the rise of designer eggs that look just like regular ones but carry a superior and customized nutrient profile.

Key words: Designer egg, Omega-3, Anti-oxidant, Minerals, Enriched Designer Eggs, Immunomodulating Eggs

Introduction

During the last decade it has become clear that our lifestyle, which includes diet, stress, smoking, medical attention, exercise and genetics is a major determinant of our health status and resistance to different diseases. In this context diet plays the most important role. So traditionally, food products like egg have been developed for taste, appearance, value, and convenience for the consumer. An egg is one of the most nutritious food items in our diet. Egg is a “Nature’s original functional food” (Hasler *et al.*, 2000) packed with 13 important vitamins, minerals and high-quality protein, all of which are easily absorbed by the body. Eggs are a good source of essential minerals such as calcium, iron, phosphorus, zinc and iodine. When it comes to calories, a medium sized egg has about 75-76 kcal, rich in vitamin B, especially vitamin B12, vitamin A, vitamin D, vitamin E and vitamin K except vitamin C. In spite of all positives, it is being often blamed as

high cholesterol food because of its lipid profile in the yolk. Due to this a cholesterol phobia has been raised among the health cautious populations, which leads to a declining trend in egg consumption throughout the globe especially in western countries (FAO, 2003). Not only this, the world-famous weekly magazine ‘Time’ has devoted one of its issue covering cholesterol phobia as lead topic to make the larger population aware of it (Wallis, 1984) In the backdrop of above facts, the concept of “Designer Egg” has been evolved with aim to minimise the health negative nutrients (viz. cholesterol and triglycerides) and enriching it with health positive nutrients viz. ω -3 fatty acids and antioxidants, vitamins and minerals (Ankari, 1998).

Designer egg is the egg whose nutrient contents have been modified from the standard egg. Simply they can be expressed as ‘Nutritionally enhanced, Value added, Supplemental eggs’.



How to design the egg/methods of designing the egg

Designer eggs are produced primarily by scientifically modifying the diet of laying hens so that specific nutrients are naturally deposited into the egg yolk and albumen. The process begins with nutritional supplementation, where the feed is enriched with targeted ingredients such as flaxseed, fish oil, algal meal, vitamin E, selenium yeast, iodine sources, probiotics, or herbal additives depending on the type of designer egg desired. These nutrients are absorbed through the hen's digestive system and transferred into the developing egg without any artificial injection or genetic modification.

Types of designer eggs

Low cholesterol eggs

A large egg contains approximately 200-220 mg of cholesterol. Lowering egg cholesterol in egg can be brought out by dietary manipulation or pharmacological intervention (drugs). Drugs have been successful in lowering egg cholesterol by as much as 50%. Drugs lower cholesterol in the egg by either inhibiting the synthesis of cholesterol in the hen or by inhibiting the transfer of cholesterol from the blood to the developing yolk on the ovary. At present, the drugs which have shown promise in lowering cholesterol are not yet approved by the FDA for commercial use. By supplementing chromium from 250-1000 ppb at the interval of 250 ppb in different groups will significantly decrease the egg cholesterol along with yolk cholesterol (Yildiz *et al.*, 2004). On the basis of same line (Sahin *et al.*, 2001) supplementing the chromium in the poultry diet and observe to reduce the yolk and plasma cholesterol beneficially in contrast to the control group.

Another way of reducing the cholesterol concentration in yolk by supplementation of copper. Addition of different amount of Cu to ration of laying hens resulted in decrease yolk cholesterol and blood cholesterol (Ankari *et al.*, 1998). Supplementing the copper upto 300

mg/kg feed in the diet of poultry will help in reduction of yolk cholesterol along with plasma cholesterol (Osman *et al.*, 2013)

Ω-3 enriched designer egg

As ω-3 fatty acids cannot be synthesized in human body and are supposed to carry out a number of vital functions including regulation of blood lipid profile and inflammatory response with immune-modulation (Yashodhara *et al.*, 2009). Having different functions as prevents the cardiovascular disorders, Lowers the circulating cholesterol, Suppresses the inflammatory process, Regulates the triglyceride, LDL and HDL, and Enhances immune system. Different dietary sources Fish and Fish oils- Cold-water fish such as salmon, mackerel, menhaden, halibut, and herring, Plants- Flax seed (Linseed), Soyabean, Walnut, and Oils -from Canola, Safflower and vegetable oils and Marine algae.

Antioxidant enriched designer eggs

Egg is a rich source of natural antioxidants like vitamin-E, selenium, carotenoid pigments, flavinoid compounds, lecithin and phosvitin. These compounds will 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. Supplementation of vitamin E or fish oil (as source of Vitamin E) in the ration of layers led to a linearly increase in content of α-Tocopherol in a dose dependent manner. Vitamin E supplementation not only increased the content of α-Tocopherol but also maintained the higher concentration of ω-3 fatty acids in yolk similar to those of fresh egg. This has led to better shelf life and keeping quality of egg also over a period of 4 weeks (Meluzzi *et al.*, 2000)

Mineral enriched eggs

The shell contains the majority of the minerals in an egg. There are approximately 2,200 mg of calcium and 20 mg of phosphorus



in the shell. There has been very little success in changing the calcium and phosphorus content of the albumen and yolk. It is possible, however, to increase the content of selenium, iodine and chromium. This has been done through dietary supplementation of the hen. These three minerals are important in human health. Therefore, there has been some interest in producing designer eggs rich in these minerals.

Selenium enriched

Introduction of organic selenium in the form of Se-enriched yeast into poultry diets was a revolutionary decision, making it possible to produce egg with an increased Se concentration. Main form of selenium in the egg is Seleno-methionin (Se-met) (Yaroshenko *et al.*, 2003) Human Health benefits of Selenium are Reduces arthritis, C.V.D., cataract, cholestasis, macular degeneration, muscular dystrophy (Yaroshenko *et al.*, 2003) Cancer protecting effect. Improves blood fluidity by metabolic modification of lipoproteins (Abdulah *et al.*, 2006)

Pigment enriched eggs

The colour of the yolk is a reflection of its pigment content. In addition, the type of pigment in the egg and its concentration are directly influenced by the dietary concentration of any particular pigment. Consumer preferences vary greatly on yolk colour, even in the same country. Colour is described on the basis of the Roche Colour Fan (RCF). Yolk colours from 6 to 15 can be achieved by using only natural pigment obtained from natural raw materials. Natural sources can be from plants such as marigold, chili, or corn. The high protein blue-green algae known as Spirulina has also been shown to be a very efficient pigment source for poultry skin and egg yolk. Pigment enriched eggs may be beneficial in preventing macular degeneration, a major cause of blindness in the elderly. Higher intake of carotenoids reduced the risk of age-related

macular degeneration. The most effective carotenoids were lutein and zeaxanthin, which are commonly found in dark-green leafy vegetables, such as spinach and collard greens. Most of the carotenoids in egg yolk are hydroxy compounds called xanthophylls. Lutein and zeaxanthin are two of the most common xanthophylls found in egg yolk. Lutein and zeaxanthin are high in pigmented feed ingredients such as yellow corn, alfalfa meal, corn gluten meal, dried algae meal and marigold-petal meal. Both lutein and zeaxanthin are efficiently transferred to the yolk when these various feed ingredients are fed to laying hens. The egg processing industry has routinely produced highly pigmented yolks for use in bakery products, pasta and mayonnaise. The dark yolk colour has better acceptance by Indian consumers. With a growing problem of macular degeneration in the elder people, there is a great market potential for these eggs.

Immunomodulating eggs

Chicken egg is abundant in antibodies like “IgY”; which is cheaper and better than mammalian immunoglobulin “IgG”. In a 6 week period, a hen produces about 298mg of specific antibodies, compared with only 17mg from a rabbit. This “IgY” can be used to treat human rotavirus, *E. coli*, *Streptococcus*, *Pseudomonas*, *Staphylococcus* and *Salmonella* infections. The lysozyme (G1-globulin), G2 and G3 globulins, ovomacroglobulin, antibody - “IgY” and other natural antimicrobials and immune stimulants in the egg, prolong the life of AIDS patients, by their high nutritional value, as well as immune stimulant and antiviral properties. 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) at 0.3-0.5 per cent dietary level is having the highest ability to boost the IgY level in the egg. Other herbs like

Rosemary, Turmeric, Garlic, Fenugreek, Spirulina, Aswagandha, Arogyapacha etc. are also possessing immune modulating properties.

Table 1: Table shows Nutrient content and Quantity per 100g of egg contents (Parmar, M. R. et al., 2022)

Nutrient content	Quantity per 100g of egg contents (2 eggs)	
	Ordinary egg	Designer egg
Total saturated fatty acids	3.3g	2.8g
Total unsaturated fatty acids	6.4g	6.9g
MUFA	4.4g	4.4g
PUFA	2.0g	2.5g
ω-3 fatty acid	0.03g	0.7g
ω-6 fatty acid	1.9g	1.4g
ω-6 /ω-3 ratio	17.3	1.27
EPA+ DHA	0.08g	0.4g
Cholesterol	400mg	320mg
Carotenoids	1.5mg	2.5mg
Vitamin E	2mg	15mg
Selenium	Traces	1.8µg
Chromium	Traces	1.0µg

Conclusion

The egg is considered as nature's most complete food contain high-quality protein unsaturated saturated fatty acid an excellence source of iron, phosphorus and other minerals and all vitamin except vitamin C. Although being the best source of all the vital nutrients, high cholesterol content is the major constraint for egg consumers. By designing the egg to incorporate several health promoting components, it could be the finest vehicle of nutrients from animal to man. Nutritional interventions like supplementation of chromium, copper, herbs, probiotics, ω-3 fatty acids, antioxidants etc. seems to promising candidate for this purpose Demand of such eggs in the market is gaining momentum which is expected to be on rise in coming future. Viewing its need more research should be undertaken in this area for future scope.

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