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Jadhav Mahesh Digambar
Technical Officer, VHPL,
Tanuku, Andhra Pradesh, India

Mahipal Choubey
Assistant Professor, Banaras
Hindu University, Varanasi,
Uttar Pradesh, India

K Sangli Vikram Kumar
Technical Officer, VHPL,
Tanuku, Andhra Pradesh, India

P Suvethika
Technical Officer, VHPL
(PDDL), Tanuku, Andhra
Pradesh, India

Designer egg: A nutritional approach

Jadhav Mahesh Digambar, Mahipal Choubey, K Sangli Vikram Kumar and P Suvethika

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. This review focuses on the different methods or ways of improving the nutritional quality of eggs by enhancing levels of anti-oxidants and n-3 fatty acids such as docosahexaenoic acid (DHA). The advantages of simultaneous enrichment of eggs with vitamin E, carotenoids, selenium and DHA include better stability of polyunsaturated fatty acids (PUFA) during egg storage and cooking, high availability of such nutrients as vitamin E and carotenoids, absence of off-taste and an improved anti-oxidant and n-3 status of people consuming these eggs. Having reviewed the relevant scientific literature it is concluded that “designer eggs” can be considered as a new type of functional food.

Keywords: Designer egg, PUFA, cholesterol, probiotic, copper, chromium, ω -3 enriched designer egg, antioxidants, herbs.

Introduction

Egg is considered as natural life supporting chemical storehouse which provides highly nutritious food with biological packaging (egg shell) without any chance of adulteration. It is blessed with all the essential nutrients which can nourish an embryo to a chick. Eggs have been described as “Nature’s original functional food” (Hasler *et al.*, 2000) [5]. They are being used world widely as food due to its protein quality (high biological value), low cost and palatability. 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) [3]. 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) [19]. 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) [1].

Effects of High Cholesterol

- Too much cholesterol can build up in arteries over time.
- Leads to Atherosclerosis in vital arteries.
- Cause heart attacks and strokes.
- A major constituent of gallstone.

How to Design the Egg/Methods of Designing the Egg

A designer egg may be characterized by an egg whose nutrient contents have been altered from the standard one in term of essential fatty acids, cholesterol, vitamins, minerals, antioxidants etc (Sim, 1998) [15]. Simply they can be expressed as ‘Nutritionally enhanced, Value added, Supplemental eggs’. A typical designer egg may have cholesterol level reduced upto 40% and omega-3 fatty acids increased by 6 times as in regular egg (USDA, Nutrient Database, 2011) [18]. As per Narahari (2006) [10] egg is a best vehicle to incorporate several health promoting components in it, therefore possibilities for designer egg are limitless. Such an alteration of various nutrients in an egg could be easily achieved by nutritional manipulation of the laying hens ration (Singh and Sachan, 2010) [16].

Correspondence
Jadhav Mahesh Digambar
Technical Officer, VHPL,
Tanuku, Andhra Pradesh, India

Low Cholesterol Designer Egg

They can be produced by using different supplements in the layers ration.

Supplementation of Chromium

The main constraint of egg *i.e.* cholesterol can be easily manipulated by supplementation of chromium. 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) [22]. On the basis of same line Sahin *et al.* (2001) [13] supplementing the chromium in the poultry diet and observe to reduce the yolk and plasma cholesterol beneficially in contrast to the control group.

Supplementation of Copper

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) [1]. 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) [11]. Increasing the dietary copper intake through the use of different copper compounds is not affecting the layer performance and also the cholesterol content of the egg (Pekel, 2011) [12].

Supplementation of Probiotics

“Microbial feed additive that have a beneficial effect on the health and well-being of the host” (Fuller, 1989) [4]. Effect of probiotic is mediated via Improved nutrient utilization, Digestive enzyme secretion, Appetite stimulation, Optimization of gut health, Immune modulation (Toms and Powrie, 2001) [17]. Also help increase in daily feed consumption and nitrogen and Ca retention (Nahashon *et al.*, 1996) [9].

Using multi-strain of Probiotic 0.5g/kg of feed supplementation in laying hen diet will leads to increase the Egg production and decrease the yolk cholesterol significantly (Khan *et al.*, 2011) [6]. On the basis of same line supplementing the probiotics (*Rhodobacter capsulatus*) in layers ration at different rate from 0.01 to 0.04% will also decrease the yolk cholesterol along with yolk triglycerides (Salma *et al.*, 2007) [14].

Supplementation of Herbs

Supplementation of Garlic to laying hen for over 16 week at different levels from 0 to 10% in their diet will significantly lower the serum as well as yolk cholesterol (Chowdhury *et al.*, 2002) [2]. Yalcin *et al.* (2007) [20] Supplementing Garlic Powder in layers rations which gives positive effect on the reduction of Blood Serum Cholesterol level in 300 layers for 21 weeks. They also show the supplementing the PUFA in diet of layers will gives reduction of cholesterol level in layer diet in diet of layers.

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) [21]. 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.

Among all the sources flaxseed oil is the richest source followed by fish and soybean oil. Supplementation of flaxseed oil at different levels from 0%, 1.5% and 3% (Yalcin *et al.*, 2007) [20] and fish oil at the rate of 0%, 2%, 3% and 4% (Maurice, 1994) [7] as source of omega-3 fatty acids at the varying levels in the diet of layer bird resulted in eggs enriched with important ω-3 fatty acids (ALA, EPA and DHA) significantly.

Antioxidant Enriched Designer Eggs

In today's lifestyle everyone has to experience a lot of stress. These stresses are mediated via oxidative processes which generate a lot of free radicals and peroxides inside the body. Dietary antioxidants are the best counter for such stresses. Designing the eggs with higher content of antioxidant is an added way out. Egg naturally contains antioxidant substances like Vitamin E, Vitamin A, and Selenium etc. But their levels are not sufficient to protect Designer eggs rich in omega-3 fatty acids

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 (Meluzzi, *et al.*, 2000) [8]. 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 (Meluzzi, *et al.*, 2000) [8]. This has led to better shelf life and keeping quality of egg also over a period of 4 weeks (Meluzzi, *et al.*, 2000) [8].

Such egg are now gaining momentum in the global market under different trade names, however Indian market is more encouraging in metro cities and Southern part due to higher number of nonvegetarian and health cautious population. Nonetheless, increasing health awareness and purchasing power of masses is a hope for growth of its market.

Conclusion

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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