Article Id
AL04247

DESIGNER EGGS

[1]Komal Chauhan* and [1]Sreeja S.J.

Email
chauhankomal603@gmail.com

[1]Animal Nutrition Division, ICAR-National Dairy Research Institute, Karnal, Haryana, India

Egg is considered as "nature's original functional food" (Hasler *et al.*, 2000). Eggs are considered the highest quality protein. Besides this, eggs also serve as the major source of dietary cholesterol, containing 213 mg cholesterol per egg. However, consumer awareness on the relationship between dietary lipid and the incidence of Coronary Heart Disease (CHD) and occurenece of *Salmonella* changed the attitude of people towards egg consumption. But, subsequent research suggests that dietary cholesterol in general and cholesterol in eggs in particular has limited effects on the blood cholesterol level and on cardiovascular disease. Despite this, a cholesterol scare exists among consumers which leads to a declining trend in egg consumption throughout the world especially in western countries (FAO, 2003). The poultry products like eggs have already gained a healthy image, so in order to curb the prevalence of chronic diseases several attempts were made to modify the eggs by adding ingredients which are beneficial for the health or by eliminating or atleast reducing the harmful components. In the backdrop of above facts, the concept of "designer egg" has been evolved with an approach to minimize the negative compunds (viz. cholesterol and triglycerides) and enriching it with health positive compounds viz. ω-3 fatty acids and antioxidants, vitamins and minerals.

Nutrient Composition of Eggs

The egg is one of the most complete and versatile food. Egg is a rich source of quality protein (high bioavailability i.e., more than 80%), important source of unsaturated fatty acids (oleic), iron, phosphorus, trace minerals, vitamin A, E, K and B complex vitamins, especially vitamin B. Traces of carbohydrates (1.0 per cent) are present in egg content. The lipid content in egg is 11.87 per cent of egg content and 32.8 per cent of yolk. Yolk is a complex milieu containing 68% low-density lipoproteins (LDL), 16% high-density lipoproteins (HDLs), 10% livetins and other soluble proteins, and 4% phosvitins. The egg white is a gel-like structure

that lacks lipids and is composed mainly of water (about 88%), fibrous structural proteins (ovomucins), glycoproteins (ovalbumin, protease inhibitors), antibacterial proteins (lysozyme), and peptides. Egg-white ovalbumin thus represents a valuable source of amino-acids for human nutrition. Besides ovalbumin, egg white is rich in antibacterial lysozyme that has potential as an anti-infectious agent in many pharmaceuticals and as food preservative. The total lipid content is relatively stable in the egg ranging from 8.7 to 11.2 per 100 g of whole egg. Egg does not contain any fibers and its content in carbohydrates is low (0.7%). The egg and, more precisely, the egg yolk, is a vitamin-rich food that contains all vitamins except vitamin C (ascorbic acid). The absence of vitamin C in the egg may result from the fact that birds are capable of satisfying their own vitamin C requirements, by de novo synthesis from glucose. The egg yolk contains high amount of vitamin A, D, E, K, B1, B2, B5, B6, B9, and B12, while egg white possesses high amounts of vitamins B2, B3, and B5 but also significant amounts of vitamins B1, B6, B8, B9, and B12. In addition to these vitamins, eggs represent a major source of choline, which is essentially concentrated in the yolk (680 mg/100 g in the egg yolk versus 1 mg/100 g in the egg white). Egg is rich in phosphorus, calcium, potassium, and contains moderate amounts of sodium (142 mg per 100 g of whole egg). It also contains all essential trace elements including copper, iron, magnesium, manganese, selenium, and zinc, with egg yolk being the major contributor to iron and zinc supply. The presence of such minerals and micronutrients in egg is quite interesting as a deficiency in some of these (Zn, Mg, and Se) has been associated with depression and fatigue and development of pathological diseases. Due to low caloric value and easy digestibility, egg is included in the diet of older people. In the egg, all the essential amino acids are present.

Designer Egg

Designer egg production can be defined as a pre-oviposition technology to exploit products (egg) beyond their traditional food value and is the enrichment of egg retaining their nutritional, functional and sensory qualities. Designer eggs can also be termed as enriched eggs or nutritionally enhanced eggs are called as, pre-ovipositor value added eggs or health promoting designer eggs. Research priority in poultry nutrition has been diversified into the field of enriching or fortifying eggs with certain nutrients of consumer's choice at pre-oviposition itself based on the basic concept that eggs accumulate nutrients if hens are subject to dietary and nutritional manipulations (Sujatha and Narahari, 2011). Eggs can be designed

through dietary approaches either through supplementation of specific nutrients, or certain herbs or specific drugs that have functional and therapeutic properties.

Need for Modifications in Eggs

The growing role of human nutrition in both the treatment and prevention of chronic diseases has led to the convergence of the consumer and governmental attention on the nutritional quality of foods. The food industry has responded to the demand for foods of superior health benefits by modifying the nutritional profile of popular foods like eggs and meat.

Egg is a cholesterol rich food. A large egg contains about 213 mg of cholesterol per yolk (USDA, 1991). Even though the nutritional superiority of the egg has been proven beyond doubt, the assumptions that egg consumption will increase the serum cholesterol levels directly, has resulted in reduced egg consumption. This "cholesterol phobia" scared the people in developed countries until 1990 and still continues to do so in developing countries including India due to ignorance. It was assumed that high cholesterol leads to atherosclerosis in vital arteries which may cause heart attacks and strokes and also is a major constituent of gallstone. Although the nutritionists and cardiologists have now established that there is only an insignificant correlation between dietary and serum cholesterol levels; the consumers are still scared of consuming cholesterol rich foods, hence there is an urgent need to reduce the egg yolk cholesterol levels as well as to incorporate several other health promoting components in the egg. Due to limited successful attempts to significantly reduce cholesterol content of eggs through genetic, nutritional, pharmacological tools, researchers have also turned towards using the egg as vehicle for delivering essential nutrients that were traditionally absent or in low concentration in those products. The industry is presently geared in production of speciality eggs that have higher or enriched levels of certain nutrients already present in the eggs or lower the levels of other nutrients, which are considered undesirable for some reasons. Such eggs are called “designer eggs", “functional eggs”, “diet eggs”, which are capable of safeguarding the health of the consumers.

History of Designer Egg Production

Cruickshank (1934) was one of the first researchers to document the ability to change the nutrient profile of the egg. In the late 80s, Sim, Jiang and their associates worked together to produce nutrient enriched eggs and developed designer egg, rich in n-3 fatty acids with

antioxidants and patented this egg as 'Professor Sim's Designer Egg'. Later in 1997, Van Elswyk developed eggs enriched with conjugated linoleic acid (CLA). In Australia, Farell (1998) enriched the eggs with folic acid and iron. Other available designer eggs in the market include eggs enriched with vitamins (Michella and Slaugh, 2000). In Canada, Leeson and Caston (2004) produced lutein and selenium enriched eggs which help in preventing eye disorders. In India, Narahari (2005) has also developed Herbal Enriched Designer Eggs (HEDE), which is not only rich in carotenoids, n-3 PUFA, selenium, trace minerals and vitamin E, but also rich in herbal active principles like Allicin, Betaine, Euginol, Lumichrome, Lumiflavin, , Lutein, Sulforaphane, Taurine and many other active principles of herbs, supplemented in the diets of hens. These eggs also contain natural sterols (phytosterols) like β-sitosterol, Brassicasterol, Campesterol, Stigmasterol etc. which are cardiac friendly in nature.

Methods for Designer Egg Production

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

Dietary Manipulation for Designer Egg Production

Egg nutrients that can be manipulated by dietary manipulation are - Cholestrol , fatty acid profile: n-3 fatty acids Linoleic and Linolenic acid ;Vitamins : A,D, E, K, B12, Biotin, Folic acid and minerals- Cr, Se, Fe, Zn, I, Mn etc. Dietary mainipulation is an easy method for enrichment of eggs but there are certain factors that need to be considered before enrichment of 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 (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 a modern diet.
- Possible interactions with assimilation of other nutrients from the egg
- Stability during cooking
- Effect of nutrient enrichment on appearance and taste (Vitamin E, carotenoids and selenium do not affect egg taste but help prevent fishy taste in ω-3 eggs)

Conclusion

Due to the cholesterol fear, egg consumers have developed certain taboos regarding egg consumption. This has resulted in the development of concept of designer eggs. Designer eggs provide varying nutritional benefits or properties compared to generic eggs. Dietary manipulation for designer egg production is dependent on several factors which must be considered while formulating the diets for laying hens. Designer eggs with new functional properties are highly demanding, however, still there is lack of knowhow for their commercial production.

Reference

Hasler CM. (2000) The changing face of functional foods. Journal *of American College Nutrition*. 19:499- 506.

Narahari D (2005). Nutrient manipulations for value added eggs and meat production. Conference of Indian Poultry Science Association and National Symposium-2005.

FAO. State of Forest and Tree Genetic Resources in Dry Zone Southern Africa Development Community Countries. Document prepared by B.I. Nyoka. Forest Genetic Resources Working Papers, Working Paper FGR/41E, Forest Resources Development Service, Forest Resources Division. FAO, Rome (unpublished), 2003.

Sujatha T., and Narahari, D. (2011). Effect of designer diets on egg yolk composition of 'White Leghorn' hens. *Journal of food science and technology*. 48. 494-7.

Michella SM and Slaugh BT (2000), Producing and marketing a specially egg. *Poultry Science* 79: 975- 976.

Leeson S and Caston L (2004). Enrichment of eggs with lutein. *Poultry Science*, 83(10): 1709-1712.