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Review

Importance of designer eggs for the Nigerian population

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Epidemiological studies have led to recommendations that people should consume at least two servings of fruit and three servings of vegetable daily for healthy living but majority of Nigerians falls well short of meeting these guidelines. Hence, there is a need to make up for this shortage. Through studies, it has been established that in addition to being a natural functional food, the egg's nutrient content can be altered by designing the feed given to the chickens thus resulting in the production of designer eggs. A crucial feature of these designer eggs is the synergistic combination of healthy Omega-3 fatty acids with major antioxidants, Vitamin E and lutein, as an important approach to the improvement of the human diet. These eggs will not be able to replace vegetable and fruits as a major source of natural antioxidants and fish products but can substantially improve the diet, especially in a country like Nigeria, significantly contributing to the recommended daily intake of essential nutrients. Thus, this study reviews the importance of designer eggs in the Nigerian context.

Key words: Vitamin E, designer egg, omega-3 fatty acids, antioxidants, lutein, Nigeria.

INTRODUCTION

Eggs have been described as "Nature's original functional food" (Hasler, 2000) packed with various important vitamins and minerals. Eggs are said to contain the highest quality protein, when compared to other animal protein sources and they are inexpensive when compare to other protein sources.

Chicken's eggs have been used as a food by human beings since antiquity. Compared with the hen's egg, no other single food of animal origin is eaten by so many people all over the world and none is served in such a variety of ways. Its popularity is justified not only because it is so easily produced and has so many uses in cookery, but also because of its nutritive excellence.

The nutrient value of one egg have been tabulated in Table 1 and per the World Health Organization (WHO) recommendation, 2 eggs per day are required for optimum growth.

Eggs contain a number of beneficial nutrients, some of which have functions that are currently being studied. Egg yolks provide an excellent, highly bio-available source of the carotenoids, lutein and zeaxanthin (Handelman et al., 1999). Recent research demonstrated the link between these dietary compounds and the macular pigment of the retina of the eye (Landrum and Bone, 2001). Lutein and zeaxanthin are the primary carotenoids found in the macular region. Sufficient quantities of these nutrients in the diet are thought to reduce the risk of age-related macular degeneration, a

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Table 1. Nutritional value of one large egg.

S/N	Nutrient	Amount
1	Calories	70 kcal
2	Total fat	4.5 g
3	Saturated fat	1.5 g
4	Polyunsaturated fat	0.5 g
5	Monounsaturated fat	2.0 g
6	Cholesterol	213 mg
7	Sodium	65 mg
8	Potassium	60 mg
9	Total carbohydrate	1 g
10	Protein	6 g

Source: Hargis (1988).

leading cause of blindness in the elderly.

In addition to possibly reducing the risk of macular degeneration, lutein has been associated with a protective effect for early atherosclerosis. Dwyer et al. (2001) reported that increased amounts of dietary lutein from green leafy vegetables and egg yolks could be protective against atherosclerosis by slowing the progression of atherosclerotic lesions in humans and animals. Early arteriosclerosis was inversely related to levels of plasma lutein which were affected by dietary intake indicating an inverse relationship between dietary lutein and arteriosclerosis development.

Choline is a nutrient naturally found in eggs that has been identified as contributing to fetal memory and brain development. Choline is found in the form of phosphatidylcholine and sphingomyelin, which are types of phospholipids. Choline's chief function in the body is as an important part of cellular compounds such as the neurotransmitter acetylcholine and lecithin, a naturally occurring emulsifier present in cell membranes and bile. One large egg contains approximately 300 mg choline. Eggs are good sources of choline since the recommended daily intakes range from 425 to 550 mg for adults, including pregnant and lactating women, according to the National Academy of Sciences (Yu and Sim, 1987).

Eggs naturally contain essential and functional nutrients to promote health. In addition, the nutrient content of eggs can be modified to provide nutrients above and beyond what is normally found in generic shell eggs.

Surprisingly, even with the clear picture of the advantages of eggs and its low cost when compared to other protein sources like meat, fish and other animal proteins, the consumption of eggs per day has been found to be on the decline in recent years.

DESIGNER EGGS

Designer eggs are eggs produced when hen is fed with special feed prepared to suite the nutrients one desires to be present in the egg produced. The benefits of the designer eggs are manifold; the one of highest order is the benefit it offers in terms of the fatty acid content.

Fatty acid content

Genetic selection of hens for lowered cholesterol has not been successful in lowering the egg cholesterol content. Thus, research into lowering egg cholesterol has centered mostly on diet and pharmacological intervention (drugs). Drugs have been successful in lowering egg cholesterol by as much as 50% (Sim et al., 1973). 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. But, the drugs which have shown promise in lowering cholesterol are not yet approved by the Food and Drug Administration (FDA) for commercial use.

Research has also shown that the most effective way to lower egg cholesterol content is alter the diet of the hen. Thus, introducing the concept of designer eggs, a designer egg is and egg laid by chicken feed with a special diet of feed.

Clinical and epidemiology research has proved that the consumption of small quantities of Omega-3 fatty acids (0.5 g/day) over a long period of time decreases the coronary heart disease mortality rate (Sim, 1990).

Altering the total fat content in the diet of the hen has little effect on the total fat content of the egg yolk. However, the fatty acid profile (or the ratios of the different types of fatty acids) of egg yolk lipid can easily be changed, simply by changing the type of fat used in the diet.

Consumption of polyunsaturated fatty acids has been reported to reduce the risk of atherosclerosis and stroke. Consumption of these fatty acids has also been shown to promote infant growth. Different feeds, such as flaxseed (linseed) (Caston and Leeson, 1990; Jiang et al., 1992; Nowokolo and Sim, 1989; Sim, 1990), safflower oil, perilla oils (Shrimpton, 1987), marine algae (Hargis, 1988) fish, fish oil (Hargis et al., 1991; Yu and Sim, 1987) and vegetable oil have been added to chicken feeds to increase the Omega-3 fatty acid content in the egg yolk.

The use of Omega-3 fatty acid rich eggs, showed a reduction in plasma and liver total cholesterol produced by 20 and 40%, respectively (Sim et al., 1973).

Omega-3 fatty acid-rich eggs may provide an alternative food source for enhancing intake of these 'healthy' fatty acids. Studies confirmed that designer eggs rich in Omega-3 fatty acids though rich in cholesterol do not provoke plasma cholesterol production instead suppress the low-density lipoprotein (LDL)-cholesterol production and increase the high-density lipoprotein (HDL)-cholesterol production (Sim et al., 1973).

Studies of the eggs during storage indicated that the

shelf life of the enriched eggs was comparable to that of typical eggs (Sim et al., 1973).

Many Omega-3 fatty acid-enhanced eggs are available in the U.S. market under various brand names such as Gold Circle Farms, Egg Plus, and the Country Hen Better Eggs (Sim, 1990).

Omega-3 fatty acid-enriched eggs taste and cook like any other chicken eggs available in the grocery store. However, they typically have a darker yellow yolk.

Additional benefits

Mineral content

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 (Yu and Sim, 1987). This has been done through dietary supplementation of the hen. These three minerals are important in human health.

Vitamin content

Designer eggs that have been produced contain higher concentrations of several vitamins. Two vitamins, A and E, are receiving the most interest as components of designer eggs. The vitamin content of the egg is variable and is dependent on the dietary concentration of any specific vitamin.

Pigment content

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. Yolk colors can be achieved by using only natural pigments 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 (Landrum and Bone, 2001).

Recent research has shown that eggs may be beneficial in preventing macular degeneration; a major cause of blindness in the elderly. A recent study indicated that 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 hydroxyl 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 (Landrum and Bone, 2001).

Fortunately, both lutein and zeaxanthin are efficiently transferred to the yolk when these various feed ingredients are fed to laying hens. With a growing problem of macular degeneration in the elderly, the egg industry may want to seize this opportunity to produce lutein and zeaxanthin rich eggs.

WHY INTRODUCE DESIGNER EGGS IN NIGERIA

Traditionally, food products have been developed for taste, appearance, value, and convenience for the consumer. Epidemiological findings, supported by animal studies, have led to recommendations that people should consume at least two servings of fruit (like apples, grapes, bananas etc.) and three servings of vegetable (carrots, green peas, cabbage, tomatoes etc.) daily. Majority of Nigerians falls well short of meeting these guidelines. The population face severe issues with malnutrition most of which goes unnoticed until complications arise and thus can benefit greatly from the consumption of eggs.

Recent reports of increase in cardiac problems among the Nigeria population have be documented, indicating an increase in cholesterol in the population this may be due to the high animal fat consumption in the country. The Nigeria populations are inclined to the consumption of animal products which consists of more than 60% of total lipids, 70% saturated fats and 100% cholesterol. A large egg contains approximately 200 to 220 mg of cholesterol (Simopolous, 1991). Thus, it is of importance to look into means of combating the resultant heart diseases and cardiac problems faced by the population. Thus it may be of interest for Nigeria to tap into the benefits offered by designer eggs.

Consumption of polyunsaturated fatty acids has been reported to reduce the risk of atherosclerosis and stroke. Consumption of these fatty acids has also been shown to promote infant growth (Simopolous, 1991). For a long time the only dietary source of Omega-3 fatty acids was from fish and studies have shown that the consumption of these fatty acids protect against cardiovascular and inflammatory diseases as well as certain kinds of cancers (Beare-Rogers, 1991; Simopolous, 1991).

Other benefits include reduction in plasma triglycerides, blood pressure, platelet aggregation, thrombosis and atherosclerosis (Simopolous, 1991).

Different feeds, such as flaxseed (linseed) (Caston and Leeson, 1990; Jiang et al., 1992; Nowokolo and Sim, 1989; Sim, 1990), safflower oil, perilla oils (Shrimpton, 1987), marine algae (Hargis, 1988) fish, fish oil (Hargis et al., 1991; Yu and Sim, 1987) and vegetable oil have been added to chicken feeds to increase the Omega-3 fatty acid content in the egg yolk.

Recent research has also shown that eggs may be

beneficial in preventing macular degeneration, a major cause of blindness in the elderly. Thus, the development of eggs rich in lutein and zeaxanthin will also be of interest to the elderly population.

Thus, designer egg enriched in Vitamin E, lutein and Omega-3 fatty acids cannot be only a good nutritional product but also a good vector for the delivery of four essential nutrients vital for human health. A crucial feature of these designer eggs is the synergistic combination of healty fatty acids with major antioxidants, Vitamin E and lutein, as an important approach to the improvement of the human diet. These eggs will not be able to replace vegetable and fruits as a major source of natural antioxidants and fish products but can substantially improve the diet, especially in a country like Nigeria, significantly contributing to the recommended daily intake of essential nutrients.

Since most of the substances or raw materials required for the production of the designer feed such as yellow corn, dried algae meal, dried fish meal and alfalfa meal which can be used for the production of designer eggs are commonly found in Nigeria, its production in house can be easily carried out. But in order to implement the production of designer eggs it is important that studies be conducted using different combinations of feed in order to attain the desired nutrient values which will suite the Nigerian population requirements.

Conflict of Interests

The author(s) have not declared any conflict of interests.

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