Designer Foods: Egg Products

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Abstract

Last year, 158 million Americans – 85% - used a dietary supplement. Whether to simply maintain health or manage/treat a condition, nine out of ten shoppers prefer naturally nutritious foods to supplements (FMI/Prevention, 1999; HealthFocus 1999). In its efficient ovoid container, eggs are naturally a functional food providing valuable nutrients, from the high-quality protein to significant levels of beneficial vitamins, antioxidants, and other healthful compounds. In addition to the egg being a natural functional food, the egg's nutrient content can be altered by the feed given to chickens. Consumers can now find eggs with even less cholesterol and saturated fat than typical and with an added bonus of increased vitamin E and omega-3 fatty acids.

Introduction

Eggs have been described as "Nature's original functional food" (Hasler, 2000) packed with thirteen important vitamins and minerals. Eggs are also considered the highest quality protein, yet compared to other animal protein sources, eggs are the most inexpensive. The values for the nutrients in one large egg are found in Table 1. Table 2 lists the percentage of the recommended daily value for various nutrients for two large eggs in the diet and illustrates the nutrient density of eggs. While one large egg contributes only 70 calories, it significantly contributes to the protein, vitamin B12, folate, selenium, riboflavin, vitamin D, phosphorus, and vitamin A daily requirements.

Eggs contain a number of beneficial nutrients, some of which have functions that are currently being studied. Egg yolks provide an excellent, highly bioavailable 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 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

TABLE 1. Nutritional Value of One Large Egg

Nutrient	Amount
Calories	70 kcal
Total Fat	4.5 g
Saturated Fat	1.5 g
Polyunsaturated Fat	0.5g
Monounsaturated Fat	2.0 g
Cholesterol	213 mg
Sodium	65 mg
Potassium	60 mg
Total Carbohydrate	1 g
Protein	6 g

TABLE 2. Percentage of Daily Value Provided by Two Large Eggs

Nutrient	Percent (%) Provided
Energy	6
Protein	20
Essential Amino Acids	53
Vitamin B12	16
Folate	12
Selenium	34
Vitamin B6	8
Iron	8
Riboflavin	30
Vitamin D	12
Phosphorous	16
Zinc	8
Vitamin A	12

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Proceedings of the 54th Reciprocal Meat Conference (2001)

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 milligrams choline. Eggs are good sources of choline since the recommended daily intakes range from 425 to 550 milligrams for adults, including pregnant and lactating women, according to the National Academy of Sciences (Zeisel, 2000).

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.

Designer Eggs

In an effort to meet the growing demands of health conscious consumers, the egg industry is developing new designer eggs. A small percentage of eggs (estimated 3 to 5%) sold are 'Designer Eggs' because they contain nutrients or added factors that set them apart from generic eggs.

The possibilities for designer eggs are limitless. For this presentation, designer eggs may be categorized as 1) nutritionally enhanced, 2) value added, and 3) added processing.

Nutritionally Enhanced

Nutritionally enhanced eggs are produced by hens fed diets with modified feed content. Altering the content of the feed of the laying hen produces eggs with enhanced nutrient content. The designer eggs currently available include vegetarian eggs and eggs with modified fat content.

Hens fed an all grain diet, free of animal fat and byproducts, lay eggs marketed as vegetarian eggs. Vegetarian eggs may differ slightly in nutrient content from generic shell eggs depending on the nutrient content and quality of the vegetarian feed. This type of designer egg appeals to individuals who are lacto-ovo-vegetarians.

Eggs with modified fat content have become very popular and are available in many parts of the country. Modified fat content eggs are marketed as containing less cholesterol, less saturated fat, higher amounts of omega-3 fatty acids, higher vitamin E content, and high amounts of iodine when compared to generic shell eggs. The reported cholesterol level of modified fat eggs is 190 mg per egg in comparison to 215 mg in generic eggs, and the saturated fat content is 1.0 grams compared with 1.5 grams in generic eggs. The differences in the nutrient profile of the modified fat eggs are due to the nutrient content of the feed for the hens. Hens are typically fed all grain diets supplemented with canola oil, bran, kelp and vitamin E.

Studies have shown that diets high in omega-3 fatty acids can reduce heart disease risk. Hens fed diets high in omega-3 fatty acids produce eggs with high omega-3 fatty acid content in the yolks. The type of omega-3 fatty acid in the feed can be linolenic acid from flaxseed or docosahexanoic acid (DHA) or eicosapentaenoic acid (EPA) from marine algae or fish oil. Individuals who do not eat or do not have access to fish products can consume an adequate amount of omega-3 fatty acids by incorporating omega-3 eggs into their diet. Table 3 shows a comparison of the types of fats found in two types of designer eggs as well as generic shell eggs.

Several studies have evaluated the effects of designer eggs on plasma levels of certain nutrients in humans. In a controlled trial, Surai et al. (2000) fed human volunteers one designer egg or one table egg each day for eight weeks. The designer eggs were enriched in vitamin E, lutein, selenium, and DHA. The designer eggs had 26 times more vitamin E, 16 times higher carotenoid content, over seven times greater selenium content, and six times higher DHA content than generic eggs. Plasma samples were collected before and after the eight-week feeding period. Alpha-tocopherol (vitamin E), lutein and DHA significantly increased in the plasma of subjects fed designer eggs when compared to subjects fed generic shell eggs. The authors concluded that DHA, vitamin E and lutein from eggs may improve the diet and could result in beneficial health parameters.

In a similar study, Farrell (1998) enriched eggs with omega-3 fatty acids and fed human volunteers the enriched eggs for twenty-two weeks. The subjects consumed seven eggs per week for the first twenty weeks and approximately ten eggs per week for the last two weeks. The control group received the same number of generic eggs. Consumption of one enriched egg per day significantly increased levels of EPA, DHA and total omega-3 fatty acids in blood. High density lipoprotein (HDL) levels gradually rose in the subjects throughout the 24 week feeding study while total blood cholesterol lev-

TABLE 3. Comparison of Fat and Antioxidant Levels in Designer and Generic Eggs

	Generic Egg	Reduced Fat Egg	Modified Omega-3 Egg
Total Fat (g)	4.5	4.0	4.5
Saturated Fat (g)	1.5	1.2	1.5
Linolenic acid (mg)	17	>50	1000
DHA (mg)	18	>50	100-150
Total Omega 3 (mg)	33	>100	100-150
Linoleic Acid (mg)	500	>100	100
Cholesterol (mg)	213	190	213
Vitamin E (IU)	1.1	7.5	6.0

els and triacylglycerol levels did not increase. The author concluded that eggs enriched with EPA and DHA could contribute to the dietary intake of omega-3 polyunsaturated fatty acids and could be an alternative source of omega-3 fatty acids to fish.

Value Added

Organic and free-range eggs are marketed as value added eggs and are available in many parts of the United States. Organic eggs are produced under the guidelines of the USDA National Organic Standard Board with third party certification. Everything that affects the production of the egg must be certified organic for the egg to be considered organic, from the hen's feed to the amount and type of space the hens live in, to the chemicals in the wash water. Organic eggs have the same nutrient content as generic eggs if the feed is of the same quality (Watkins, 1995).

Free range eggs are produced by hens that are not kept in cages. Hens have daily access to outdoors, depending on the climate. The nutrient content of free-range eggs is identical to generic eggs if the feed quality is equivalent. Free-range eggs are not nutritionally enhanced unless the feed is modified.

Some eggs are marketed as 'Hormone Free'. This description may be misleading to consumers since all eggs are produced from hens that are not given hormones (Anonymous 1999).

Added Processing

New technologies continue to be introduced in food processing. The latest one commercialized for eggs is pasteurization of shell eggs. Pasteurization has been used for years for liquid egg products; however, the technology to pasteurize a whole shell egg is relatively new. The process involves heating eggs to specific temperatures in water baths designed to heat the egg enough to destroy pathogenic bacteria but not enough to coagulate the proteins. The eggs are held in the water baths for long periods of time at carefully controlled temperatures. The eggs are then cooled and packaged. Eggs pasteurized in the shell are exempt from the United States Food and Drug Administration (FDA) refrigeration rule effective June 2001 and the safe handling instruction rule effective September 2001.

Other new technologies are in the development process to improve the safety of shell eggs. One such technology is irradiation. The FDA approved irradiation for treatment of shell eggs in 2000. To date, irradiated eggs have not yet been produced for the consumer market.

Conclusion

Designer eggs provide options for consumers who want eggs with different nutritional benefits or properties than generic eggs. A generic shell egg provides a nutrient dense, high quality, inexpensive source of protein as well as a variety of essential vitamins and minerals, with other functional components. By feeding hens special diets, eggs can offer functions above and beyond the excellent nutrition that they already provide.

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