

Nutritionally enhanced eggs

Nutritionally enhanced eggs are produced by varying the diet of hens.

Omega-3 enriched eggs

- Omega-3 fatty acids are a family of polyunsaturated fatty acids.
- Important omega-3 fatty acids are derived largely as eicosapentaenoic acid (EPA) and docosahexaenoic acid (DHA) from fish oil and alpha linolenic acid (LNA) from plant oil.
- These fatty acids are protective against coronary heart disease, inflammation diseases and several cancers.
- Egg lipid profile is related to the concentration of lipids in a hen's diet.
- Dietary changes affect the arrangement of triglycerides and phospholipids in the liver, and affect the yolk synthesis.
- Flax seed is the most widely used ingredient in the production of omega-3 eggs.
- Flax seed provide linolenic acid and hen converts linolenic acid to the EPA and DHA.
- However, their quantities can be increased to greater extent by feeding them on fish meal or fish oils.
- Another possibility is to utilize processed algae which are the original source of omega-3-fatty acid found in fish oil.
- The omega-3 enriched eggs are the first nutritionally enhanced product, which is produced successfully on commercial scale.

Lutein enriched eggs

- Lutein is considered to be an important nutrient in the human diet, as it may help to prevent age-related macular degeneration (AMD) and partial or complete blindness associated with this condition.
- Research showed that increasing the amount of lutein in the diet of laying hens led to an increase in lutein in egg yolks.
- Lutein is supplied as a synthetic supplement, but efficiency can be enhanced by inclusion of dietary ingredients such as corn gluten meal and/or alfalfa.
- However, the researchers were unable to increase egg yolk lutein content upto 1.7mg/60 g of egg contents. This is 5-8 times the level found in eggs from normally fed layers.
- However, the estimated daily requirement of humans for lutein is about 8 mg/day.
- Research continues in an effort to further increase the level of lutein in enriched egg yolks.

Folic Acid or Folate enriched eggs

- There is general agreement among nutritionists that the human diet is marginal or deficient in folic acid.
- Folate in the blood stream reduces birth defects and also influences the level of homocysteine in the blood, a factor in prevention of heart disease.
- Scientists studied the incorporation of dietary folic acid into eggs, where it appears as 5-methyltetrahydrofolate.
- Levels of up to 50µg per egg were achieved, and this represents approximately 25% of the supposed human daily requirement.
- Eggs from hens on unsupplemented diets contain about 17µg of folate.

Selenium enriched eggs

- Functions in immunoregulation, protect cells from the damage of oxidative stress and reduce risk of cardiovascular disease, several cancer and inflammatory diseases.
- Selenium content in plant based food depends on its availability from soil, and in animal based food depends on its availability from diet.
- Dietary supplemented selenium for laying hens resulted in an improvement in egg production, internal egg quality, and egg shell quality.
- However, a high level of selenium is toxic.
- Feeding organic selenium to layers can increase egg selenium 7-fold when compared with unsupplemented hens.
- Egg selenium may also be increased by feeding inorganic selenium, but the process is not as efficient as when organic sources are used.

Other Egg Enhancements

A variety of other possible enhancements to eggs have been studied, but not necessarily applied commercially.

CLA

- Conjugated linoleic acid is the name given to a mixture of isomers of linoleic acid that occur in the fats of ruminant animals and in dairy products.
- Their health effects were originally thought to be as anti-carcinogens, but subsequently, they have also been associated with lipid metabolism and with the immune system.
- As nutritional advice tended to reduce consumption of red meat and dairy products in order to avoid saturated fats, so consumption of CLA also tended to decrease.
- CLA occurs naturally in eggs, but at very low levels. The level of CLA in eggs can be raised by feeding it in the hens' diets, to the point at which one egg might provide 15-40% of the presumed daily requirement of the human. So far, (early 2009) this has not been practiced commercially.

Vitamins

- Many of the Vitamins are naturally present in eggs in significant amounts (see the section on Egg Composition). Attempts to increase Vitamin levels in eggs have met with mixed results because the hen naturally deposits only the amount necessary to support embryonic growth and development.
- Levels of the following Vitamins and micro-nutrients have been successfully increased by raising the levels in the hens' diets: Vitamin A, Vitamin D3, Vitamin E, Vitamin B12 folic acid, riboflavin, biotin and pantothenic acid.
- However, the rate at which these nutrients are incorporated into eggs varies enormously.
- In many cases, the cost of increasing the Vitamin level cannot be recovered by an acceptable increase in the price of the eggs.

Antibodies

- Antibodies are naturally deposited into eggs by the hen to provide protection for the newly hatched chick against pathogens.
- In natural conditions, antibodies will be deposited to protect against pathogens that the hen has herself encountered.
- However, it has been found that hens may be artificially induced to raise antibodies against many "foreign" antigens, and deposit them into egg yolks in relatively large quantities. These can be antibodies against human diseases.
- Subsequently, the antibodies may be extracted from the yolk, or the yolks or eggs used directly by humans to provide passive immunity or even to treat an existing disease condition. The antibodies may also be used in a variety of diagnostic tests.
- Among the antibodies that have been produced from eggs are:
 - *E. coli*
 - *Bovine Serum Albumin*
 - *Human Serum Albumin*
 - *Salmonella (various serotypes)*
 - *Proteoglycan*
 - *α -subunit of insulin receptor*
 - *lipopolysaccharide*
 - *Bovine rotavirus*
 - *Human rotavirus*
 - *Yersinia ruckeri*
 - *Staphylococcus aureus*