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Popular Article

Designer Eggs: A Cutting-edge Strategy for Enhancing Human Health

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Abstract

Designer foods have gained considerable attention in recent years for their beneficial effects on human health. Eggs are more affordable and richer in superior-quality proteins, lipids, trace elements, and vitamins involved in diverse physiological functions such as muscle proliferation, cerebral growth, retina function, and nutrient metabolism. Designer eggs are crafted to alter their nutritional composition to satisfy the user's preference. Designer eggs' preference has increased nowadays for their properties including low cholesterol, cancer-preventing agents, inflammation alleviators, free radical scavengers, and countless beneficial health.

Introduction

According to the United Nations, the exponential growth of the human race globally culminated in a situation where there is a disparity in protein availability and future demand. It has pushed 735 million people to the state of malnourishment and triggered food security threats for 2.4 billion people in the future. Malnutrition signifies insufficient or excess nutrients or a disproportion of essential nutrients. Eggs are abundant in superior-quality proteins and lipids at an affordable price and aid in confronting the issue of malnutrition. Although eggs are highly nutritious, they may trigger an imbalance in nutritive status contingent on the physiological status of the individual. This prompted

the concept of designer eggs, whose nutritive values are modifiable according to consumer preference. Designer eggs where the nutritive content is modified or designed before making necessary interventions in the layer's ration (Singh *et al.,* 2012). It is done by either adding specified nutrients or removing the unwanted ones. Not all nutrients in the diet provided to hens get incorporated into the egg. This concept allows modification in the lipid, cholesterol, and protein profiles of an egg and enriches it with minerals, various pigments, and vitamins (Murai *et al.,* 2001). The nutrient composition of designer eggs significantly varies from standard eggs to the variation made in diet.

Table 1: Difference between nutritive value of ordinary and designer eggs per 100 g (Narahari *et al.,* 2005)

Nutrients	Ordinary eggs	Designer eggs
Polyunsaturated fatty acids	2.0 g	2.5 g
Alpha linolenic acid (omega-3-fatty acids)	0.03 g	0.7 g
Linoleic acid (omega-6-fatty acids)	1.9 g	1.4 g
EPA and DHA (omega-3-fatty acids)	0.08 g	0.4 g
Omega-6 fatty acids/omega-3- fatty acids (ratio)	17.3 g	1.27 g
Cholesterol	400 mg	320 mg
Selenium	traces	1.8 µg
Chromium	traces	1 µg
Vitamin E	2 mg	15 mg
carotenoids	1.5 mg	2.2 mg

Optimizing the nutritive value of eggs:

Fortification egg with essential fatty acids:

Polyunsaturated fatty acids (PUFA) include alpha-linolenic acid (ALN), eicosatetraenoic acid (EPA), and docosahexaenoic acid (DHA), fall under the category of omega-3- -fatty acids, linoleic acid under

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omega-6- fatty acids. Eggs are highly concentrated in linoleic acid, whereas inadequate in omega-3 fatty acids, proven to be effective in preventing cardiopathies, vision impairment, osteoarthritis, and cognitive progression in infants. Commercial eggs contain 0.03 grams of omega-3 fatty acid, which can be enriched up to 0.7 grams by altering the layer hen ration. The aquatic or plant-origin concentrated ALN in eggs underwent conversion into EPA and DHA. The aquatic sources include fish-based meals or oil, and seaweed incorporated in feed. The principal concern with the use of fish meal or oil is that it affects the organoleptic properties of the egg yolk. The Schizotrichium sp. Seaweed is employed commercially as a source of omega-3 fatty acids; moreover, carotenoids in the algae provide oxidative stability. Among the plant sources, flax seed and linseed are remarkable resources of PUFA to enrich poultry meat and eggs. Observable reduction in the digestion of protein and bioavailability of minerals is a concern in incorporating flax seeds. *Brassica nigra*, nuts of Juglans, and leafy vegetables are also abundant in ALN (Muduli *et al.,* 2018). Conjugated linoleic acid (CLA) is considered indispensable and pivotal in metabolism to prevent obesity and diabetes. It also possesses inflammation-dampening properties and prevents oxidative stress. The requirement of CLA can matched by incorporating it at a level of 5%, which enriches its level of around 0.31 gram to 1 gram.

Curtailing cholesterol content in eggs

Cholesterol is the foremost reason for cardiovascular disease, a sequel of fat deposits in cardiac vessels. Commercial eggs contain around 0.213 g of cholesterol/yolk (Parmar *et al.,* 2022). In the past decades, multiple interventions in poultry rations alters the lipid profile of eggs beneficial to human health. Feeding trace elements like chromium, vanadium iodine, and copper alone or synergistically with vitamins C, B3, and A shown to have a hypocholesterolemia effect. Recent research emphasized that including the *Lactobacillus acidophilus* strain as a probiotic is beneficial in lowering the LDL profile of poultry products, especially eggs. Including the synthetic amino acids (methionine, tryptophan, and glycine) and vegetable oil concentrated in PUFA (seeds of sunflower, linseed, and canola) in ration alters the lipid profile that yields lean meat.

Fortification eggs with minerals and vitamins

Trace elements are pivotal in nutrient metabolism, egg production, and shelf life. In practical rations minerals such as copper, selenium, iodine, and chromium are used to enrich the eggs. Administration of selenium in either inorganic (selenium salts) or organic (selenium-bound yeast) form; the bioavailability is significantly higher in the organic form (Muduli *et al.,* 2018). In chickens, selenium increases egg production and improves shelf life, and in humans, it acts as an anti-

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carcinogen, counteracts inflammation, and reduces oxidative stress through the enzyme glutathione peroxidase. It also reduces the risk of cardiovascular disease, arthritis, cataracts, and muscular dystrophy. Enriching the eggs with around 700 micrograms of omega-3 fatty acid was proficient in lowering plasma cholesterol. Chromium-enriched eggs enhance nutrient metabolism specific to carbohydrates (glucose tolerance factor).

Enriching eggs with PUFA may lead to the production of free radicals that end up in rancidity. Vitamin E is a formidable natural antioxidant incorporated in layer feed to counter free radical synthesis and ensure the quality extends the shelf life. Incorporating at the level of 100 IU of vitamin E/kg of feed provides stability in omega-3 fatty acid-enriched eggs and improves their shelf life. In chickens, vitamin E enhances feed intake, egg production, yolk index, and Haugh units, and in humans, it improves the antioxidant status in plasma and prevents cardiovascular disease, cancer, and arthritis. The addition of other vitamins, including K, D, B, and C, has gained attention for its beneficial effects on human health.

Utilizing phytogenic additive to augment egg nutritional composition

In the modern era, incorporating phytobiotics in poultry rations is scientifically proven to show growth-promoting effects. On feeding, Active ingredients of these herbs alter the nutritive value of the eggs and meat shown to be advantageous to human health (Darmawan *et al.,* 2022). Studies suggested that incorporating allylic sulfide or allicin, statin, nirangenin, and lycopene from garlic, brewery waste, citrus pulp, and tomato in feed has significantly reduced LDL cholesterol levels in eggs. Feeding sterols derived from soybean and alfalfa meals decreases the cholesterol content in eggs and produces lean meat. Flavonoids, carotenoids, lutein, bay leaves, and sulforaphane present in turmeric, red pepper, bay leaves, and cruciferous vegetables significantly increase the antioxidant status of poultry products on feeding. Eggs are an affordable source of superior-quality globulins (IgY) used to enrich the immune status of human beings affected by immunosuppressive disorders. Recent studies emphasized that the eugenol/eugenic acid present in basil leaves shown to have an immunomodulatory effect. The inclusion of herbs Ashwagandha, Rosemary, and Arogyapacha in the feed elucidates the immunomodulatory effect to enrich the globulin antibodies level in the eggs. Quercetin, citogenin, and luteolin in fenugreek seeds and other spices have an anti-diabetic effect by stimulating insulin secretion.

Novel techniques to enrich an egg

Hens accumulate gamma globulins in the eggs for the exposed epitopes. Considering this, immunologists developed a novel technique by exposing the hen to a target antigen to augment the

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respective antibodies said to be pharmaceutically enriched eggs (Parmar *et al.,* 2022). The organoleptic properties of the eggs improved by intensifying the yolk and skin color by feeding natural carotenoid pigments at a level of 1 to 5 percent as a whole ingredient or 0.05 to 0.1 percent as the extracted active ingredient, including zeaxanthin and cryptoxanthin (maize), lutein (alfalfa meal), meal of marigold petals, Paprika, and blue-green algae. Grounded red chili and turmeric are included in the feed at 0.5 kg and 1 kg per ton for their anti-microbial and yolk color-intensifying properties. Carotene also elevates the level of xanthophyll and free radical scavengers in meat and eggs that preserve quality and increase durability. The incorporation of ethoxyquin in PUFA-enriched eggs can provide oxidative stability.

Conclusion

Including oil seeds or oil, seaweeds, fish meal or oil, herbs, spices, synthetic vitamins, and minerals in layer hen ration improves the quality of the eggs and shelf life. Designer eggs are exponentially superior to conventional eggs. They are low in cholesterol and have a high concentration of PUFA. Minerals (copper, selenium, chromium, vanadium) and vitamins make designer eggs saturated with cancer-preventing substances and free radical scavengers. Designer eggs fortified with immunomodulators have high levels of globulin antibodies employed in the therapeutics of immunosuppressive disease. Thus, considering the aforementioned factors, designer eggs emerge as a promising remedy that prompts the health and well-being of humans.

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