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Designer eggs and conventional eggs: Nutritional characteristics and basic principles of production

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Intricacies of the subject

Eggs are one of the cheapest, most nutritious and frequently consumed sources of animal food worldwide. Eggs are appreciated for their good quality protein, amino acids, vitamins, minerals, fatty acids, and various bioactive components. Being relatively inexpensive easily processed and highly nutritious, eggs significantly contribute to food and nutrition security, especially in developing nations. Within the poultry industry, chicken egg is the most common type of commercial egg produced; however, eggs from other poultry such as ducks, quails, turkeys and other domestic fowl are also consumed by people. Modern poultry farming has transformed egg production through advances in genetics, nutrition, housing, disease management and precision farming. These have enabled productivity of quality and safety oeggs. Now, however, consumer interest does not rest merely on the production aspect but extends to the nutritional aspect of eggs. This has led to growing interest in designer or nutritionally enriched eggs, in which the concentrations of selected nutrients such as omega-3 fatty acids, selenium, vitamin E, vitamin D, lutein and other bioactive compounds can be modified through the hen's diet.

Introduction

Designer eggs are those that result from the feeding of hens with special diets in order to either modify or enhance the presence of some specific nutrients or substances within the eggs. They are also referred to as nutritionally enriched eggs or functional eggs. The main purpose is to provide an egg with a specific nutritional profile rather than simply increasing egg production. Through targeted poultry nutrition, the eggs can be enriched with nutrients like omega-3 fatty acid, selenium, vitamin E, vitamin D, lutein, zeaxanthin and other beneficial substances.

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Table 1: Major types of designer eggs and their dietary enrichment approaches

Type of designer egg	Dietary approach	Major component increased
Omega-3 egg	Flaxseed, fish oil, algae oil	α-linolenic acid, EPA/DHA
Vitamin E egg	Vitamin E supplementation	Vitamin E
Selenium egg	Organic/inorganic selenium	Selenium
Iodine egg	Iodine supplementation	Iodine
Lutein/zeaxanthin egg	Marigold meal/extract, carotenoid-rich ingredients	Lutein and zeaxanthin
Vitamin D egg	Appropriate vitamin D supplementation/management	Vitamin D
Herbal/antioxidant egg	Garlic, turmeric, herbs, plant extracts, etc.	Bioactive compounds/ antioxidants

Selection and management of laying hens

Production of designer eggs starts with the selection of healthy laying hens having similar age, genetic composition and egg production status. Also, the hens should be acclimatized for a proper period prior to starting any dietary treatment so that the hens get used to experimental housing and basal diet. Body weight, feed consumption and egg production can be assessed during this period to evaluate the homogeneity of the experimental groups before starting any dietary intervention.

Formulation of special diets

It is essential to use an experimentally well-designed diet for the creation of designer eggs by means of nutritional manipulation. The dietary manipulation of the laying hens could result in changes in the level and profile of the selected nutrients or bio-actives present in the eggs. Therefore, the amount of the selected nutrient or bioactive in the diet needs to be determined in accordance with its nutritional requirements, bioavailability, transfer rate to the egg, and safety levels. A low level of supplementation may not be adequate enough to elicit any rise in the concentration of the target element, while a high level may have adverse effects on feed consumption, nutritional efficiency, animal health, egg production, and egg quality. Therefore, various levels of the dietary element under study are usually tested to determine an ideal level of supplementation.

How does the nutrient reach the egg?

Designer eggs are produced by taking advantage of the hen's natural ability to transfer nutrients from her diet into the developing egg. When a hen consumes a diet enriched with a particular nutrient or bioactive compound, the components are digested and absorbed through the gastrointestinal tract and then transported through the bloodstream. After absorption, these nutrients are utilized or metabolized by the hen and made available to the reproductive system. During follicular growth and egg formation, selected nutrients and their metabolites are incorporated into different parts of the developing egg, particularly the yolk and albumen. The amount of a nutrient deposited in the egg depends on several factors, including its dietary level, bioavailability, chemical characteristics, metabolism and the physiological condition of the hen. Therefore, by carefully modifying the diet of laying hens, it is possible to increase concentration of specific nutrients or bioactive compounds in eggs and produce nutritionally enriched or designer eggs.

Conventional eggs versus designer eggs

The nutrition provided in conventional eggs comes from laying hens fed on diets designed

to satisfy the maintenance needs, growth, and egg production needs of the hen. Eggs are nutritious by nature and contain proteins, lipids, vitamins, minerals, and some biologically active substances. It is thus clear that the main difference between conventional and designer eggs lies in the nutrition provided rather than in the fundamental structure of the egg. The amount of nutrients in conventional eggs is determined by the genes, physiology, age, production system, and the diet of the hen. In designer eggs, the intake of specific nutrients by the hen is controlled to increase their deposition in the egg.

Table 2: Characteristics of conventional and designer eggs

Characteristic	Conventional egg	Designer egg
Production	Produced using a standard nutritionally balanced layer diet	Produced using a specifically modified/enriched layer diet
Primary objective	Normal egg production and nutritional quality	Enhancement of selected nutritional or functional components
Nutrient composition	Naturally occurring nutrient profile	Targeted enrichment of one or more nutrients/bioactive compounds
Examples	Standard table egg	Omega-3, selenium, vitamin E, vitamin D or lutein-enriched egg
Dietary intervention	No specific enrichment required	Specific nutrient or bioactive ingredient is incorporated into the hen's diet
Laboratory verification	Usually routine egg-quality evaluation	Target nutrient is generally quantified to verify enrichment
Potential nutritional advantage	Provides a broad range of essential nutrients	May provide increased amounts of selected nutrients
Production cost	Generally lower	May be higher because of specialized feed and processing/quality-control requirements

Which one is better?

From a scientific perspective, it would be wrong to say that designer eggs are always better than conventional eggs. Both have their nutritional value. The conventional egg is itself rich in proteins and various nutrients, while the designer egg's main nutritional value lies in its enrichment with certain nutrients. However, there is one thing to understand here: just because an egg is enriched nutritionally doesn't mean it has become better in all aspects. Commercial comparisons have demonstrated variation among conventional and designer eggs in parameters such as yolk colour, albumen height, Haugh unit and lipid oxidation, with no single egg type consistently showing the highest value for every quality characteristic. Therefore, it is recommended that designer eggs should be evaluated depending upon their nutritional objectives, nutrient level, safety, sensory aspects, egg quality, and performance of production.

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