



## What is the Difference Between Conventional Cages, Free-Range and Organic Eggs?

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### Abstract

Eggs are important source of high-quality protein, vitamins, minerals and fatty acids. The egg contains unique and balanced nutrients for people of all ages. Eggs were mostly produced in conventional battery cage systems until the European Union banned the cage systems. According to European regulation, egg production was allowed in enriched cage, non-cage housing systems such as aviaries, free-range and organic systems after 2012. In general, egg shell contamination may be higher in eggs produced in alternative systems. Free-range eggs have a higher risk of contamination with dioxins than barn or cage eggs. The aim of this study is to compare the eggshell microbial contamination and quality of the eggs obtained from different production systems.

**Keywords:** Eggs, Microbial contamination, Dioxin, Free-range, organic systems

### INTRODUCTION

Eggs are important source of high-quality protein, vitamins, minerals and fatty acids. The egg contains unique and balanced nutrients for people of all ages. The first four countries in egg production are China (31 million tons), USA (6 million tons), India (4.8 million tons), and Japan (2.6 million tons), respectively [1]. Egg consumption per capita per year was determined as 333, 307, 305 and 280 in Japan, China, Russia and Argentina, respectively [1].

#### Egg Production systems

The conventional cage system consists of 4 to 12 wire cages, drinking, feeding, manure removal, egg collection is designed automatically, closed in a fully controlled building system. The movement of animals is limited and more animals can be raised in the unit area. Conventional cage has been banned in Europe after 2012 by the European Council (Council Directive 1999/74/EC).

#### Enriched cages:

The enriched cages (furnished cage) are formed as an alternative to conventional cages. Conventional cages provide 450 cm<sup>2</sup> cage area for each animal, while enriched cages provide 750 cm<sup>2</sup> cage area per hen, a dust bath, nail trimmers, a nest box, 15 cm perch per hen, 12 cm feeder length per hen [2], [3], [4].

#### Barn System:

Hens are raised on the floor or in multi-tier systems. However, this system is a closed area and no out-doors area. The stocking density must not exceed nine laying hens per m<sup>2</sup> of usable area [3].

#### Free-range system:

This system is similar to the barn system, but there is an open area where animals can roam outside all day. Stocking density should be 9 hen/m<sup>2</sup> in in-doors and 4m<sup>2</sup>/hen in out-door.

#### Organic system:

Hens are kept in a free-range area and specific rules should be followed regarding using organic feed, stocking

density and limiting the use of veterinary treatments [3].

#### Egg Quality Characteristics

Egg quality is divided into two parts as internal and external quality criteria. External quality criteria are egg weight, specific gravity, shell strength, dirty and crack shell, shell microbial load. Internal quality criteria are albumen height, Haugh unit, yolk index, yolk color, albumen pH and yolk pH. Egg quality is influenced by many factors such as production system, hen age, strain, nutrition, disease and management [5], [6], [7], [8], [9], [10], [11], [12], [13], [14].

#### Egg weight:

Conventional cage eggs are heavier than free-range eggs [15], [16]. Similarly, Minelli et al., [17] reported that conventional cage eggs are heavier than organic production eggs. However, Van Den Brand et al., [18] stated that no significant differences were found between conventional cage eggs and free-range eggs for egg weight. This differences is related that egg weight was affected several factors such as strain, age, season.

#### Egg shell strength:

There are studies with different results about the effect of production systems on egg shell strength. Petek et al., [15] found no significant differences in shell strength between conventional cage eggs and free-range eggs. However, Minelli et al., [17] reported significant differences in shell strength for caged eggs compared with organic eggs.

#### Egg shell thickness:

Roberts and Chousalkar [16] reported that conventional cage eggs were thicker shell than free-range eggs. However, Leyendecker et al., [19] and Petek et al., [15] stated that free-range eggs had a thicker shell than conventional cage eggs. On the other hand, no significant differences were found for shell thickness between conventional cage and free-range eggs [18].

**Albumen height:**

Albumen height was not found to be different between conventional cage eggs and free-range eggs [18], [20]. However, Roberts and Chousalkar [16] found higher albumen height in conventional cage eggs versus free-range eggs.

**Haugh Unit:**

Hidalgo et al., [20] showed no significant differences among the cage, Free-range, barn production systems, except that organic eggs had lowest Haugh unit. However, conventional cage eggs have higher Haugh unit values than free-range eggs [16].

**Yolk color:**

Egg yolk color in the free-range system are darker than cage eggs [15], [18], but according to Roberts and Chousalkar [16], eggs in the conventional cage are darker than free-range eggs. The most important factor affecting the yellow color is the diet of the hen [4].

**Nutrient contents:**

The eggs from the free-range production system had higher total fatty acids than the eggs produced by caged hens [21]. Similarly, Total yolk fat was significantly lower in the conventional eggs than in the organic eggs [22]. The protein and cholesterol content in the organic system eggs were higher than cage systems eggs [17]. Hidalgo et al., [20] showed no significant differences among the Free-range, barn and organic production systems, except that cage eggs had lowest amount of protein. Anderson [21] reported that no significant differences were found for cholesterol, Vitamin A, Vitamin E between conventional eggs and free-range eggs.

**Egg shell microbial load:**

According to the studies, it was determined that free-range and organic system eggs contain more microorganism than cage eggs. No significant differences were found for total aerobic microorganism between free-range eggs and battery cages eggs. But Free-range eggs had a higher Enterobacteriaceae counts than the battery caged eggs [23]. The shell contamination in conventional cages eggs were lower than the furnished cage, free-range, and organic eggs ( $P < 0.05$ ). But there was no significant differences were found among furnished cage, free-range, and organic eggs [24]. Similarly, Roberts and Chousalkar [16] reported that free-range eggs have higher total microorganism count than conventional cage eggs.

**Dioxin amount:**

Home produced eggs frequently contain high levels of dioxins and PCBs. Certain eggs may contribute substantially to the exposure to dioxins and PCBs [25].

**CONCLUSION**

In terms of egg quality, cage systems appear to be in a slightly better condition than free-range or organic system eggs. In terms of shell microbial load, free-range and organic system eggs are more than cage system eggs. Free system eggs have a higher risk of contamination than cage system eggs. Free-range or organic system eggs are more likely to contain dioxins than cage system eggs.

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