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Determination Of The Heating Period Suitable For Optimum Nutritional Contents Of Boiled Japanese Quail Egg (Coturnix Japonica)

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A B S T R A C T

The study was undertaken to determine the heating duration suitable for optimum nutritional content of Japanese quail (Coturnix japonica) egg when heated in water at 63^{o}C (the temperature recommended for boiling quail egg) for (n = 10); using standard analytical techniques. By considering the heating durations 2 min, 5min, 10 min, 15 min, 30 min, 60 min and 90 min; the mean moisture content of quail egg decreased with heating, a significant loss was recorded after 15 min heating period ($P < 0.05$). The mean ash content (%) increased from the 2 min heating period (2.40%) up to 30 min (6.78%) and significantly decreased to 3.80% at 60 min and 3.49% at 90 min ($P < 0.05$). The fresh egg had the mean fat content 11.03%, this decreased steadily to 7.91% at 15 min heating, and decreased sharply by half-fold to 5.72% at 30 min and to 4.71% at 90 min heating. The protein content in the fresh sample was 15.65%, at 2 min heating (63^{o}C) this was diminished by one-fifth and by one-third at 2 and 5 min respectively; at 10 min of heating the protein value was 8.90%; this slightly diminished to 8.78% at 15 min heating time. At 30 min heating, the protein value decreased significantly to 6.26% and 5.93% at 90 min. The percentage carbohydrate in the fresh egg was 0.61%, this increased from the 2 min heating period (2.34%), and was two-fold and three-fold (7.01%) in the 5 and 10 min heating periods respectively. After which the carbohydrate content decreased to 6.55% in 15 min and further to 19.75%, 18.51% and 25.52% in the 30, 60 and 90 min respectively. Since the fat and protein contents decrease while the carbohydrate content increase with heating time at 63^{o}C, the findings indicate that optimum levels of protein, fat and carbohydrate in boiled quail egg would be attained at 10 min heating time in 63^{o}C water. At the heating duration of 10 min, it is envisaged that the medicinal efficacy of Japanese quail egg is still maintained.

Key words: *Japanese quail, heating, optimum, nutritional contents*

Introduction

Quail, common name for two groups of bird species within the galliform family: the odontophorine quails of the Americas, and a group comprising the smallest members of a Eurasian subfamily. Species of the latter group are widely distributed, with representatives on all continents and such islands as Madagascar, Japan, New Guinea, New Zealand and the Philippines (Redmond, 2009).

The common quail of Europe, similarly Japanese quail of eastern Asia and the rain quail of southern Asia, are all migratory. Japanese quail (Coturnix japonica) was successfully introduced from Japan to America, Europe and the Middle East between the 1930s and the 1950s.

The Japanese quail is a plump medium-sized bird, about 20 cm from beak to tail. Its soft, inconspicuous colouring is typical of most quails. Quail's ability to breed readily and rapidly in captivity has credited it a domestic bird for egg production in the world (Fuchs and Merlin, 2009; Tony, 2009).

Popular choices for egg consumption are chicken, duck, quail, roe and caviar, but the egg most often consumed by humans is the chicken egg, by a wide margin (Lyimo, et al., 1991). However, Japanese quail (Coturnix japonica) is becoming more popular as a source of meat and eggs in various parts of the world including Nigeria. Coturnix japonica can lay up to 350 eggs of 10 – 12 g each, which means twenty times its body weight.

Quail eggs are proved to be a very valuable source of vitamins A, B1, B2, B6, B12 and vitamin D, iron, magnesium, zinc, copper, phosphorus and other essential micro-nutrients, minerals and amino acids (Baumgartner, 1994).

The small speckle egg of Japanese quail has nutritional value that is three to four times greater than chicken egg. For instance, quail egg contains 13 percent proteins, compared to 11 percent in chicken egg. Quail egg contains more vitamins A and B2 than chicken egg, and provides five times as much iron and potassium compared to those in chicken egg. Evidences show that cholesterol level of quail egg is like that of chicken egg (Carrie, 2010; Joanne,1998).

Quail egg has both high nutritional and medical benefits (remedy of rhinitis, asthma, hay fever, skin disorder, spasmodic cough, stomach ulcer and others), so it is called a ‘Super food’ with regard to nutrition.

Heating temperature and duration of heating has depleting effect on the nutritional values of foods (Thompson, 2003; Tina and John, 2011); cooking of eggs change the structure of the constituent proteins and other nutrients; so overheating depletes inherent nutritional benefits. Proteins in raw eggs are tightly packed together and held in place by weak chemical bonds. On heating egg proteins, some of these bonds break and the proteins strands begin to separate from one another (Pieter, 1998; Mia, 2011).

Therefore, the aim of this study is to assess the heating duration suitable for optimum nutritional values of quail egg when heated in water at 63^{o}C (the temperature recommended for boiling quail egg).

Materials And Methods

Sample Collection and Treatment

Fresh quail eggs were collected from a poultry farm in Area E of Ahmadu Bello University, Zaria in May 2012. The eggs were heated in water at 63^{o}C (the optimum boiling temperature recommended for quail egg) on a thermostated hot plate at 2 min, 5 min, 10 min, 15 min, 30 min, 60 min or 90 min (n = 10).

Proximate Determination

The proximate analyses of the fresh quail eggs, and the ones obtained after being heated in water at 63^{o}C for 2 min, 5 min, 10 min, 15 min, 30 min, 60 min or 90 min were carried out for n = 10 replicates; in order to determine the percentage moisture, crude fat, total ash and carbohydrate contents, using the methods of Association of Official Analytical Chemists, 1990. While the crude protein was determined by the method developed by Kjeldahl and adopted by Pearson, (1976) and the Association of Official Analytical Chemists, 1990.

Results And Discussion

The Proximate Compositions of Blood Meal Sourced From Cattle and Goat

The albumen of all the boiled eggs were off-white irrespective of the heating duration, while the yolk were deep yellow. The proximate compositions of the raw and boiled quail eggs are presented in Tables 1.

The mean percentage moisture of the raw quail egg was 71.88 ± 2.20%, the moisture content of quail egg decreased with heating, 71.63 ± 2.46% at the 2 min heating duration to 70.38 ± 1.78% at the 5 min heating duration, after which a slightly gradual decrease to 70.15 ± 3.14% was recorded at the 10 min; 70.62 ± 4.16% at the 15 min, and a sharp decline to 61.47 ± 3.14% at 30 min; further elevation to 66.13 ± 4.66% was obtained at the 60 min duration of boiling, possibly due to enhanced permeation of water to the egg system; however, at 90 min the moisture content of the quail egg decreased to 60.34 ± 4.16%. Therefore, the trend suggests that the moisture content of quail egg decreased with heating, with a significant loss being recorded after 15 min heating period ($P < 0.05$, student’s t - test).

Following from Table 1, the ash content (%) of the raw egg was elevated as heating duration increased, it was 2.40 ± 0.24% at the 2 min heating duration, was almost doubled at the 5 min, and then gradually elevated at the 15 min then at the 30 min (6.78 ± 0.76%). After this was a drastic decline in the ash content to 3.80 ± 0.49% at 60 min and to 3.49 ± 0.93% at the 90 min of heating. This implies that the total amount of inorganic matter present in the egg were three- to six-fold the amount in the raw counterpart. So enrichment of minerals (micro and macro) in the egg resulted from elongation of heating period; the optimum being at 30 min of heating. This implicates the attitude of consuming quail egg in the raw form.

The fresh egg had the mean fat content to be 11.03 ± 0.49%, this decreased steadily from the 2 min heating period (10.07 ± 0.78%) to 7.91 ± 0.78% at 15 min heating, and then decreased sharply by half-fold to 5.72% at 30 min and 4.71% at 90 min heating. Duncan multiple range grouping indicated that a significant decrease in fat content resulted on heating quail egg in water at 63^{o}C beyond 15 min.

Table 1. Nutritional contents of fresh and boiled (63^{o}C) quail eggs as a function of heating duration

Sample	Moisture (%)	Ash (%)	Fat (%)	Protein (%)	Carbohydrate (%)
Raw egg	71.88	1.56	11.03	15.65	0.61
Boiled 2 min	71.63	2.40	10.07	12.33	2.34
Boiled 5 min	70.38	4.29	9.54	10.06	5.73
Boiled 10 min	70.15	5.58	8.36	8.90	7.01
Boiled 15 min	70.62	6.19	7.91	8.78	6.55
Boiled 30 min	61.47	6.78	5.72	6.26	19.75
Boiled 60 min	66.13	3.80	4.74	5.88	18.51
Boiled 90 min	60.34	3.49	4.71	5.93	25.52

Values are mean ± standard deviation of n = 10 determinations

As shown in Table 1, the protein content in the fresh sample was 15.65 ± 0.04% when heated for 2 min at 63^{o}C, the value was diminished by one-fifth and by one-third at 5 min and 10 min respectively; with the protein value being 8.90 ± 1.10% % at 10 min of heating; this became slightly diminished to 8.78 ± 0.18% % at the 15 min heating time. At 30 min heating, the protein content was 6.26 ± 0.09 and 5.93 ± 0.20% % at the 90 min.

The percentage carbohydrate in the fresh egg was 0.61 ± 0.01%, this increased from the 2 min heating period (2.34 ± 0.03%), and was two-fold and three-fold (7.01 ± 0.12%) in the 5 and 10 min heating periods respectively. After which the carbohydrate content decreased to 6.55 ± 0.19% % in 15 min and further to 19.75 ± 0.09%, 18.51 ± 0.12% and 25.52 ± 0.16% % in the 30, 60 and 90 min respectively. Duncan multiple range test (DMRT) indicated that a statistically significant elevation of the carbohydrate content of quail egg resulted by heating it in the water (63^{o}C) beyond 5 min.

The percentage composition of the nutrients in Japanese quail egg at medium duration of heating follows the trend moisture > protein > fat > carbohydrate > ash. The moisture content, fat, protein generally diminished with increased time of heating, while the ash increased as the heating period elongates, except beyond 60 min period. In addition, the percentage carbohydrate content of the egg was highly elevated with increased duration of heating in water at 63^{o}C.

Conclusion

Since the fat and protein contents decrease while the carbohydrate and ash contents increase with heating time at 63^{o}C. At the 10 min of heating, the ash content was five-fold, while at 15 min it was six-fold the mean value obtained in the raw counterpart. For the fat content of the egg heated for 10 min, there was a decline by 20%, while the decline was by 25% on being heated for 15 min. At the 10 min of heating, the protein content was diminished by 40% compared to the raw sample; while heating for 5 min resulted to a decline by 30% in the raw counterpart. At the 10 min of heating, the carbohydrate content was ten-fold the amount obtained in the raw egg. The findings indicate that optimum levels of protein, fat and carbohydrate in boiled quail egg would be attained at 10 min heating time in 63^{o}C water. It is envisaged that this condition would also be suitable for maintaining the medicinal efficacy of Japanese quail egg.

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