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EFFECT OF DRYING TEMPERATURES ON THE PROXIMATE COMPOSITION AND SENSORY ATTRIBUTES OF CHICKEN EGG

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ABSTRACT

A study was conducted to dry chicken eggs in order to determine the effect of drying temperatures on the proximate composition and sensory attributes of dried eggs. The albumen, yolk and whole egg were dried separately at temperatures of 50, 55 and 60°C. The drying time for the samples ranged from 7hrs20mins to 13hrs50mins. The protein and fat contents of the dried whole egg at the drying temperatures ranged from 47.52 - 50.90% and 35.12 - 35.88%; for dried egg white, 79.32 - 79.58% and 5.28 - 5.7% and for dried egg yolk, 36.08 -36.36% and 53.56 - 54.52% respectively. Results of the proximate composition showed that the nutritional qualities of the dried eggs were retained during drying thus the drying temperature did not affect the quality of eggs. The moisture contents of the dried whole egg, dried egg yolk and dried egg white at the different temperatures range from 6.25 -7.23%, 3.51-3.62% and 6.96 - 8.84%. The low moisture contents indicate that dried eggs are shelf stable. No significant difference was observed in the proximate composition and sensory attributes of the dried whole egg, egg yolk and egg white except in the aroma of the eggs dried at different temperatures.

Key words; Albumen, yolk, egg, protein, fat

INTRODUCTION

Eggs are excellent sources of high quality protein, vitamins and minerals. They are rich in protein, amino acids, vitamins and most mineral substances, the yolk and white components are all of high biological value and are readily digested. They are known to supply the best proteins besides milk (Ihekoronye and Ngoddy, 1982; Saclavik and Christian, 2008). An average large egg contributes 6.25 g of high-quality protein based on 10- 12.5% of the Daily Reference Value for protein, and 5 grams of mostly unsaturated fat (Asghar and Abbas, 2012). As an excellent source of high quality protein, 44% is found in the yolk and 56% in the egg white (Deman, 1999). Egg white is considered an ideal protein-the one by which all others are measured, because it contains all essential amino acids in correct proportion for human nutrition (Meister, 2002). Eggs offer a balanced distribution of minerals like iron, calcium, phosphorus and potassium. They also have vitamins, particularly, vitamin E (tocopherols), vitamin A (retinol), vitamin B_{12} (cyanocobalamine), vitamin B_2 (riboflavin) and folic acid (Surai and Sparks, 2001). The iron in egg yolk, like the iron in meat, is highly bioavailable; therefore eggs may be an important source of iron in diet of individuals who are deficient in iron and are lacto-ovovegetarians.

Powdered egg is used as an emulsifying agent in emulsion formulations, increasing their stability, properties and economy. It is an excellent source of high quality protein, 44% found in the yolk and 56% in the egg white (Deman, 1999). In addition, powdered egg is widely used in processed foods due to its microbiological safety and reduced volume (Caboni *et al.*, 2005). Powdered egg can be used in several preparations during processing of food in place of using liquid egg. Powdered egg products provide consistency from batch to batch as they blend well with other dry ingredients thus giving breads, cakes, bakery mixes much of their unique texture, taste and moisture. In 1982 in the advanced countries such as the United States, 12% of the total egg consumption was in the form of powdered egg products which have risen to 30% now. As a result, several new technologies, such as improved egg breaking machines, better dryers, new approaches to pasteurization, etc., have led to a variety of new egg products (Froning, 1998). However, in the developing countries, particularly Nigeria, research into powdered egg production is novel due to the non-availability of materials for drying there are few documented reports on the use of oven-drying for the production of dried egg products despite its utilization for other agricultural produce like vegetables.

Powdered eggs provide a convenient alternative to fresh eggs which makes it easier to store up to a year or longer under proper storage conditions with reduced risk of contamination as they are pasteurized and do not require refrigeration thus contributing to its microbiological safety and reduced volume (Caboni *et al.*, 2005). It can also serve as a safe guide against glut which is usually experienced in some season and serves as discouragement to production.

Owing to the poor road network, transportation of fresh eggs in Nigeria is a challenge. This is compounded because of their bulkiness, fragility and perishability (Frazier and Westerhoff, 1988; Jay, 2000) hence there is need to process it into dried products. This has necessitated the need to produce whole egg powder in ready-to-use forms to enhance their convenience and suitability for use, extend shelf life and serve as a nutrient supplement. The aim of this study was to investigate the effects of different drying temperatures on the proximate composition and the sensory attributes of dried egg.

MATERIALS AND METHODS

Fresh, whole eggs of two days old were purchased from Mandate market in Ilorin metropolis, Kwara State.The eggs were candled to confirm their freshness. The eggs were washed, weighed and cracked. The yolk was separated from the albumen and poured onto flat plates of known weight while other samples of eggs were mixed together and dried (as whole). The different portions were whipped separately and the drying method recommended by Landen and Lorient (1999) was followed using the drying oven (model Ldo-201-E) by a thin layer drying method. The drying oven was set at 50^o, 55^o and 60^oC.The three (3) egg portions were dried while the drying time was also monitored. The dried eggs samples were analyzed for proximate composition using the AOAC (2000).

The sensory attributes was evaluated by organoleptic test on the hendonic scale of 9. A panel of ten (10) scientists were initially selected to partake in a series of sugar solution of different concentrations unknown to them in order to evaluate the activeness of their taste buds. Nine (9) scientists emerged to be suitable for the organoleptic test. The sensory attributes determined include taste, texture, aroma, colour, and appearance. The different portions of dried eggs and fresh eggs were fried and coded. Each of them was served to the scientist and a hendonic scale of nine was distributed to each of them to score the product each time they were served. At the end of the test, the scores were computed and was analysed with Anova.

Drying Temperatures and Sensory Attributes of Chicken Egg

Results obtained are expressed as the mean±standard error of mean (SEM) and analysed using Analysis of Variance (ANOVA). Significant difference at 5% confidence level using Duncan multiple range test (Duncan, 1955). All analyses were done with SPSS version 16.0 software (SPSS Inc., Chicago, IL, USA).

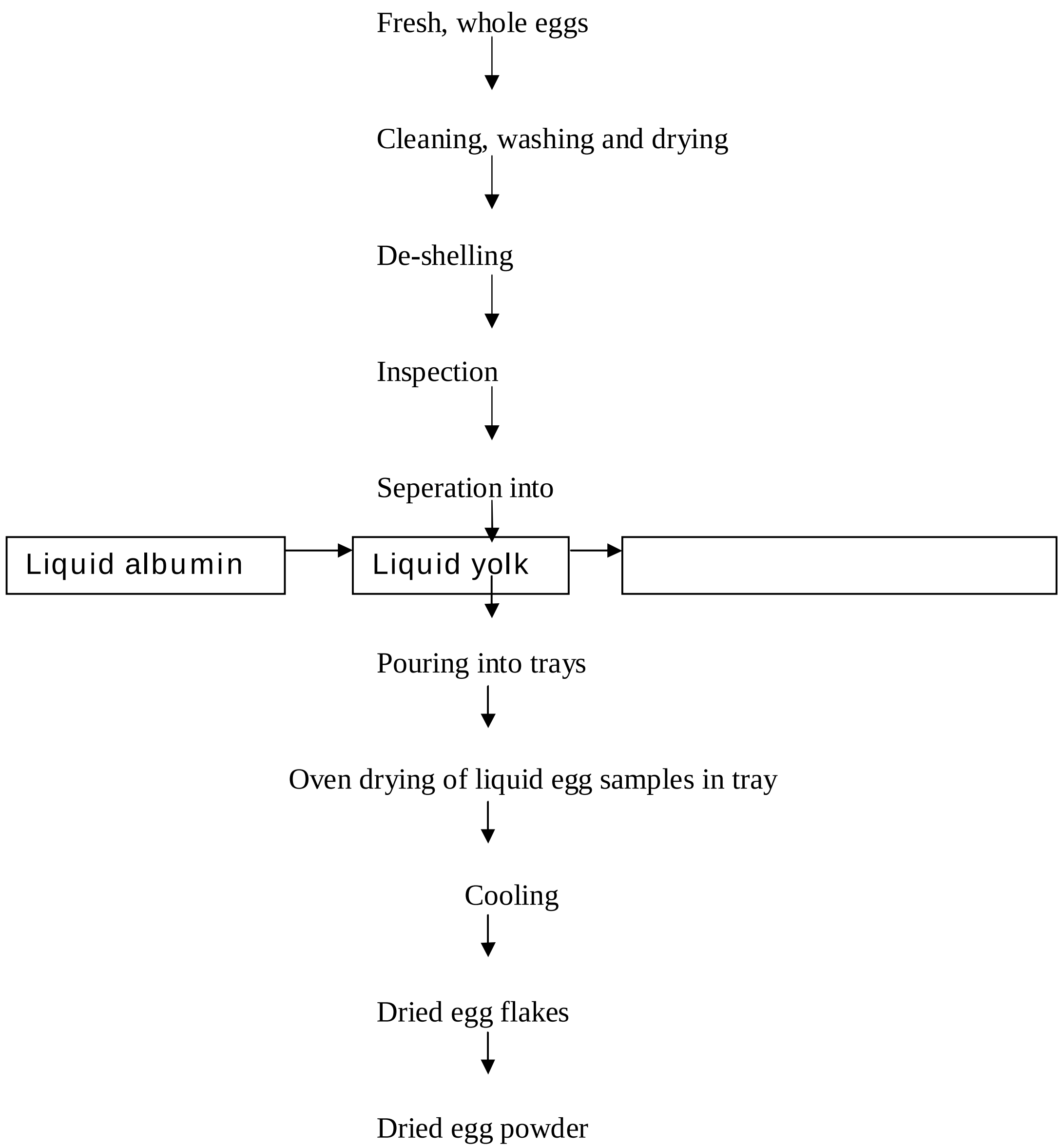

Figure 1: Flow diagram of whole egg processing into powder with some modifications. Source: Ndife *et al.* (2010)

RESULTS AND DISCUSSION

The Proximate composition of the dried whole egg, egg yolk and egg white is in table 1. The results showed that the nutritional qualities of the dried eggs for the three different parts (yolk, albumen and whole egg) were retained post-drying. Thus, the drying temperatures used did not adversely affect egg product quality. The protein and fat contents of the dried whole egg at the drying temperatures ranged from 47.52 - 50.90% and 35.12 - 35.88%; for dried egg white, 79.32 - 79.58% and 5.28 - 5.7% for dried egg white; and for dried egg yolk, 36.08 - 36.36% and 53.56 - 54.52% respectively. A general pattern of decrease in moisture, ash, fat and protein contents was observed in egg white oven-dried at 50 – 55^{o}C followed by an increase in all nutritional properties at 60^{o}C. At drying temperatures of 50 and 55^{o}C, no significant difference was observed in the moisture content of oven-dried egg yolk, followed by a significant increase ($p<0.05$) at 60^{o}C. The fat content of egg yolk increased significantly ($p<0.05$) with decrease in protein content. However, no significant difference was observed in the ash content of dried egg yolk.

The whole egg is moderate in both fat and protein. These findings were similar to the results gotten from the studies carried out by Froning, (1998). The moisture contents of the dried whole egg, dried egg yolk and dried egg at the different temperatures range from 6.25-7.23%, 3.51-3.62%, and 6.96-8.84%. The low moisture contents indicate that dried eggs are shelf stable. In addition to its antibacterial properties, the low moisture (with low water activity) in the dried egg white may also be responsible for its reduced susceptibility to microbial contamination. In the oven-dried whole egg sample, with increase in drying temperature (50^{o}C – 60^{o}C), a corresponding decrease in moisture content was observed although the values did not differ significantly ($p<0.05$). No significant difference was observed in ash content of dried whole egg. With increase in drying temperature, there was a significant increase ($p<0.05$) in protein content with decrease in fat content of dried whole egg samples.

The moisture content of the raw egg sample was significantly increased ($p<0.05$) than that in egg white, egg yolk and whole egg.

Table 1: Proximate Composition of Egg Components Dried at Different Temperature

Samples	Moisture	Ash	Fat	Protein
Egg white at 50^oC	8.79±0.07[a]	5.8±0.05[c]	5.65±0.02[b]	79.32±0.0[h]
Egg white at dried at 55^oC	7.2±0.47[c]	9.5±1.10[d]	5.7±0.12[c]	79.5±0.01[j]
Egg white dried at 60^oC	8.8±0.33[d]	5.9±0.71[c]	5.2±0.01[a]	79.3±0.02[i]
Yolk dried at 50^oC	1.91±0.06[a]	3.82±0.00[b]	54.41±0.01[i]	36.36±0.02[d]
Yolk dried at 55^oC	1.57±0.12[a]	4.43±0.05[b]	54.52±0.01[j]	36.18±0.01[c]
Yolk dried at 60^oC	3.59±0.08[b]	3.77±0.11[b]	53.56±0.01[h]	36.08±0.02[b]
Whole egg dried at 50^oC	7.23±0.01[c]	3.54±0.02[b]	35.88±0.01[g]	47.52±0.01[e]
Whole egg dried at 55^oC	6.52±0.09[c]	3.59±0.04[b]	35.28±0.01[f]	49.55±0.02[f]
Whole egg dried at 60^oC	6.25±0.11[c]	3.59±0.04[b]	35.12±0.02[e]	50.90±0.01[g]
Raw egg	74.03±0.97[e]	0.76±0.04[a]	9.87±0.02[d]	14.35±0.01[a]

Values are given as Mean ±Standard Error of Mean (SEM) at 5% level of significance

The result in table 2 is the sensory qualities of egg samples(egg white, egg yolk and whole egg) dried at 50 – 60^oC. No significant difference was observed in the colour, taste, smell, texture and appearance of dried egg white sample when compared with the fresh. Also no significant difference was observed in the colour and texture of the yolk dried between 50-60^oC, smell of the yolk dried between 50 and 60^oC and the appearance of fresh egg yolk and those dried between 50 and 60^oC. There was a significant difference between the fresh egg yolk and egg yolk dried at 50, 55 and 60^oC.

In the dried whole egg sample, a significant difference in smell and appearance was observed between the fresh whole egg and the dried egg but there was no significant difference in the dried whole egg dried at the 3 temperatures. However, there was no significant difference in the colour and taste of the fresh whole egg and the dried fresh whole egg at the 3 drying temperatures.

Table 2; Sensory Evaluation of Dried Egg at Different Temperatures

Sensory	Fresh Albumen	Albumen dried at 50°C	Albumen dried at 55°C	Albumen dried at 60°C	Fresh yolk	Yolk dried at 50°C	Yolk dried at 55°C	Yolk dried at 60°C	Fresh whole egg	Whole egg dried at 50°C	Whole egg dried at 55°C	Whole egg dried at 60°C
Colour	6.81±0.42[a]	6.40±0.43[a]	6.4±1.43 [a]	6.10±0.68[a]	8.40± 0.20[b]	6.60±0.30[a]	6.70±0.30[a]	6.50±0.60[a]	8.30±0.50[a]	6.90±0.70[a]	6.80±0.60[a]	6.10±0.80[a]
Taste	6.4±0.60[a]	5.5±0.60[a]	5.5±1.92 [a]	6.0±0.70[a]	7.50±0.40[c]	4.2±0.50[a]	6.40±0.20[bc]	5.60±0.90[ab]	7.70±0.60[a]	6.50±0.30[a]	5.60±0.60[a]	5.50±0.80[a]
Smell	6.60±0.79[a]	4.70±0.70[a]	6.4±1.75 [a]	6.4±0.40[a]	7.40±0.70[b]	5.10±0.50[a]	6.30±0.30[ab]	6.40±0.60[ab]	7.80±0.50[b]	6.60±0.40[ab]	5.70±0.40[a]	5.50±0.60[a]
Texture	6.60±0.60[a]	5.70±0.60[a]	4.7±1.08 [a]	5.90±0.60[a]	7.70±0.30[b]	4.70±0.50[a]	7.20±0.40[b]	5.40±0.70[a]	7.70±0.60[a]	6.40±0.80[ab]	5.50±0.70[a]	5.40±0.70[a]
Appearance	6.50±0.60[a]	6.8±1.48 [a]	5.7±1.48 [a]	6.30±0.60[a]	7.50±0.50[a]	5.90±0.40[a]	6.50±0.50[a]	6.10±0.70[a]	8.40±0.50[b]	7.10±0.70[ab]	6.20±0.60[a]	5.50±0.60[a]

Values are given as Mean ±Standard Error of Mean (SEM) at 5% level of significance

Drying Temperatures and Sensory Attributes of Chicken Egg

The moisture contents of the dried egg white, yolk and whole egg samples are low enough to extend the shelf life of the egg powders in an environment of low humidity (Jay, 2000) thus will help to reduce the risk of contamination and bring about increased shelf life making the egg product economically and nutritionally beneficial (Kumaravel *et al*., 2012).Egg protein is used in a variety of food products due to its excellent functional properties (solubility, emulsification, foaming and gelling) and protein quality (Soerberg, 2013). Froning (1998) reported that egg white is largely protein on a dry basis and this may account for its very high protein content than other egg components. Hence, they can be utilized as water soluble packets (pouches) for ingredients in the food, chemical, and pharmaceutical industries due to the fact that egg albumen films are clearer and more transparent than wheat gluten, soy protein isolates and corn zein films. Edible films, which can carry antioxidants, antimicrobial and spices can also be produced from dried egg white (Froning, 1998).Lipids make up about 45% of the whole egg solids and 60% of egg yolk solids.

Lipids play an important role in determining the quality of stored dried egg products, since they undergo many types of deteriorative changes such as hydrolytic rancidity, autoxidation of unsaturated fatty acids constituents and lipid browning reactions (Lea, 1957).The fat content of dried egg yolk is higher than its protein content at the 3 drying temperatures. This is in line with the report of Pomeranz (1991) who stated that egg yolk has lower protein content and higher fat content compared to egg white. This may also be responsible for itsvery low moisture content than in the egg white and whole egg as it is in fish where an inverse relationship exists between fat and moisture content. Thus, loss in moisture content results in increase of the fat and protein contents. This is also similar in fishes as reported by Ali (2012).

Thus, result from this study reveal thatthe different drying temperatures did not adversely affect the nutritional value of the oven dried egg components. Oven drying of egg components at 55^{o} C gave better nutritional quality of products. Heat treatments during drying can further ensure microbial safety and increase shelf-life of egg products but can have detrimental effects on the functional properties of egg proteins resulting in commercially undesirable finished products (Le Denmat *et al*., 1999).
The oven dried egg white, egg yolk and whole egg samples have acceptable sensory characteristics.

CONCLUSION

The result of this study show that oven-dried egg products have good nutritional properties and acceptable sensory characteristics with better results at 55^{o}C and can serve as a substitute for fresh eggs. Also, it has a merit of being separated into different components of varied nutritional compositions which could be used by the dieticians who try to curtail certain consumption of nutrients by the aged and sick. They are also suitable and convenient for use during camping, hiking, excursions, cases of emergency for physically displaced persons.

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