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# Egg Processing and Utilization in Nigeria: A Review

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## ABSTRACT

**The aim of this paper was to review egg processing technologies and consumption rate in Nigeria. Eggs contain protein and are consumed in homes across the country, especially by the middle and upper-class income earners. Eggs serve as a cheap source of protein for young Nigerians which constitute over 60% of the country's over 170 million people. Egg consumption in Nigeria is low because of the economic downturn and the high cost of importation of egg powder. Though, egg powder is in huge demand for various uses which include preparation of foods such as ice-cream, bread, cakes, biscuits, noodles, and doughnuts. It can also be rehydrated to make dishes such as scrambled eggs and omelets. Nigeria loses a lot of money due to its inability to process eggs into powder, dried eggs, frozen eggs, salted yolk, sugared yolk, pasteurized egg, cooked yolk etc. This negatively affects poultry farmers across the country who always struggle with the annual egg glut. Farmers and all stakeholders should think of processing eggs into powder and other forms to help address the issue of egg glut in the country and also increase the shelf life of eggs. This will encourage Nigerians to improve their egg consumption rate for better living and high productivity.**

**Keywords: Egg Processing Technologies, Utilization Rate, Nigeria.**

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## INTRODUCTION

Nigeria is the largest producer of eggs in Africa, with 10.3 billion eggs produced annually (PAN, 2018). But the poultry farmers in the country are yet to fully take advantage of the large production capacity by processing eggs into powder, dried eggs, frozen eggs, salted yolk, sugared yolk, pasteurized egg, cooked yolk etc. Nigerian poultry farmers usually experience a glut between February and May every year, largely because people tend to consume fewer eggs during this period of the year and there is a short shelf life for eggs (PAN, 2018). This situation results in wastage of eggs, as eggs are mostly consumed in high quantity during the festive periods such as Christmas, New Year, Easter, Id El Fitri, Id El Kabir and others (PAN, 2018). But when farmers are able to process excess eggs into powder especially for use in the food and beverage industry like what happened in other advanced countries. The country could save the $1billion used to import egg powder every year (PAN, 2018). Eggs are some of the few foods that are utilized throughout the world regardless of religious affiliations and ethnic groups (Stadelman and Cotterill, 2001). However, total egg consumption rate has been on the decline over the past few decades in the developed and developing countries because of its high cholesterol and fat content. In Nigeria, there is also low utilization of eggs simply because, the food and beverage industry use imported egg powder which is expensive. This increases the pressure on the country's foreign exchange reserves, money that could have been saved if the country processed its fresh eggs into powder. Egg producers and marketers in Nigeria lose so much income because of poor processing and storage facilities. The objective of

**Figure 1.** Chicken eggs. source: animal.mom.me.

**Figure 2**. Duck Eggs. Source: purelypoultry.com

this paper was to review egg processing technologies and consumption rate in Nigeria.

## POULTRY EGGS

Eggs are poultry products that are consumed worldwide for their nutritional contents. Local egg products do not meet the demands of the public; hence eggs from exotic birds have to be imported in order to sustain the supply of eggs. According to PAN (2018), Nigeria's annual demand for the poultry value chain was over N500bn with 165 million birds, 650,000 metric tonnes of eggs and 290,000 metric tonnes of meat demanded annually. It was reported that local production was addressing only 30% of the demand, while the rest 70% were foreign sourced. Examples of poultry eggs downloaded from the internet are shown in Figures 1, 2, 3 and 4.

## CHEMICAL COMPOSITION OF EGG

Egg is essentially composed of the shell (which is made of calcium carbonate, phosphorus and magnesium carbonate), outer shell membrane and outer layer (which is also made up of keratin and 2 mucin layer) (Abeyrathne et al., 2013). There is also inner shell membrane (made up of 2-layer forms by mucin and keratin), the albumen (thick and thin), viteline membrane (which is made up of the middle layer of carnitine and two outer layers of mucin), while the yolk has water and fat pole. Eggs consist of 3 main components: eggshell (9 to 12%), egg white (60%) and yolk (30 to 33%). Egg is composed of water (75%), proteins (12%), lipids (12%), and carbohydrates and minerals (1%) (Kovacs-Nolan et al., 2005). Proteins present in egg are distributed among the egg white and yolk, whereas lipids are mainly concentrated in the yolk. The yolk is covered with the vitelline membrane and mainly consists of water (50%), protein (15 to 17%), lipids (31 to 35%), and carbohydrates (1%). Protein present in egg yolk consists of lipovitellins (36%), livetins (38%), phosvitin (8%), and low-density lipoproteins (17%). Also, vyolk contains 1% carotenoids, which makes it yellow in color (Stadelman

**Figure 4.** Guinea fowl eggs. Source:guineafarm.com.

**Table 1.** USDA classification of eggs based on weights and sizes.

| Size/ weight class | Minimum weight/dozen eggs (g) | Minimum wt of individual egg in (g) |
|---|---|---|
| Jumbo | 840 | 70 |
| Extra large | 756 | 63 |
| Large | 672 | 56 |
| Medium | 588 | 49 |
| Small | 504 | 42 |
| Peewee | 420 | 35 |

**Source:** USDA, 2000; 2013.

and Cotterill, 2001).

## EGG GRADES AND MARKET QUALITY

Eggs are not graded for Nigerian markets but for American markets. They are sold at a flat rate of 30 eggs per crate in Nigeria. Usually, small and medium eggs are mixed with large and extra-large eggs in a tray or a dozen eggs for a uniform price. Eggs that are laid by layers for the first time are few and small in size. Extra-large eggs are produced by old layers. Since eggs are not graded for Nigerian markets, the grading of eggs is done by the method of United States Department of Agriculture (USDA). Eggs are graded for size (weight) and quality. They are grouped according to similar quality and weight and most eggs are sold as they are contained in crates or by weight. According to USDA (2000, 2013), eggs are graded so that, they will vary in weight or size. Larger eggs are sold for higher profits than smaller eggs as shown in Table 1. The interior quality is determined by candling, which involves passing eggs through a candling box containing electric bomb in a dark room to observe the condition of the white (albumen), yolk and size and air cell (Khan et al., 2017). Also the external quality of the eggs are graded. Factors considered in evaluating external quality are shell shape, texture, soundness, cleanliness and colour (Khan et al., 2017). Good eggs should have good shell quality like weight, shell percentage and shell thickness. The shape should be oval with a smooth texture which is easy to clean (Khan et al., 2017).

Interior factors are based on the size of the air cell (Khan et al., 2017). A freshly laid egg has a very small air cell. As the egg gets older or ages, moisture evaporates and the air cell enlarges. The yolk in a freshly laid egg is round and firm and is surrounded by a rather dense layer of albumen and white. As the egg ages, the albumen thins and the yolk tends to move freely and moves off the center more easily. Consequently, the yolk moves nearer the shell and becomes more visible with a darker shadow (Abeyrathne et al., 2013). Quality of the egg albumen is judged primarily by yolk movement. Black spots and the defects, sometimes, found in the yolk will cause egg to be downgraded. Blood spots larger than 1/8 of an inch, cause eggs to be classified as indelible. The eggs will either be AA best, AB second best etc (USDA, 2000; 2013; Khan et al., 2017). Examples of good quality eggs are shown in Figures 1, 2, 3 and 4 while poor quality eggs are shown in Figures 5 and 6.

## REASONS FOR PROCESSING EGGS

Eggs content (egg white and yolk), which have different

**Figure 5.** Poor quality eggs. source: chikenvet.co.uk.

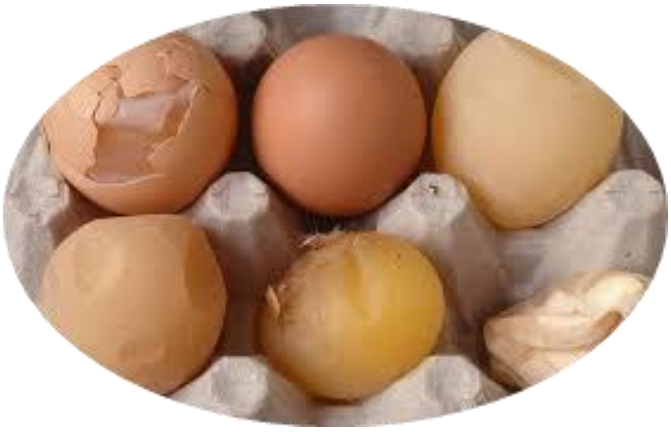

**Figure 6.** Poor quality eggs. Source: merckvetmanual.com.

baking or manufacturing properties need to be processed to suit the utilization purposes. Egg is a perishable product and vulnerable to bacteria spoilage, processing protects the eggs against spoilage during storage (King'ori, 2012). Egg has 74% water (King'ori, 2012). Therefore, oven drying removes water through evaporation, so that more solid eggs will be stored or transported with ease (Ryu et al., 2011). Processing of eggs also reduces space during storage and transportation since they are cracked, content processed to either powder or other forms and packaged. Egg production fluctuates and they are, therefore, processed and stored when the market falls, hence maintaining a steady supply of 650,000 metric tonnes of eggs to consumers per year (PAN, 2018). Statistics from FOSFAO (2013) indicate that 4kg of eggs are available to the average Nigerian yearly. That is about 11 grams of egg supply per day when compared with the globally accepted recommendation that one person take an egg per day. Eggs are also processed to other products, like dry powder and frozen liquid eggs (Beyer, 2005; Gerber, 2012) as shown in Figure 7.

## TYPES OF EGG PRODUCTS AND PROCESSING

The major products are dried eggs, frozen eggs, salted yolk, sugared yolk, pasteurized egg, cooked yolk etc.

### Dehydrated (Dried) Egg

Egg white can be pan-fried or spray-dried. In the pan-dried, the egg white is poured into a pan half inch deep and placed on a water bath at 31.9°C. The dried material is screened and sieved in spray. Dried egg white is sprayed and meets an inlet flow of hot air at 79.75°C. Vacuum removed moisture and dried products fall to the bottom. Sprayed egg white is white and contains 8% moisture. The pan-fried egg white is yellow and has 12% moisture as shown in Figures 8a and 8b.

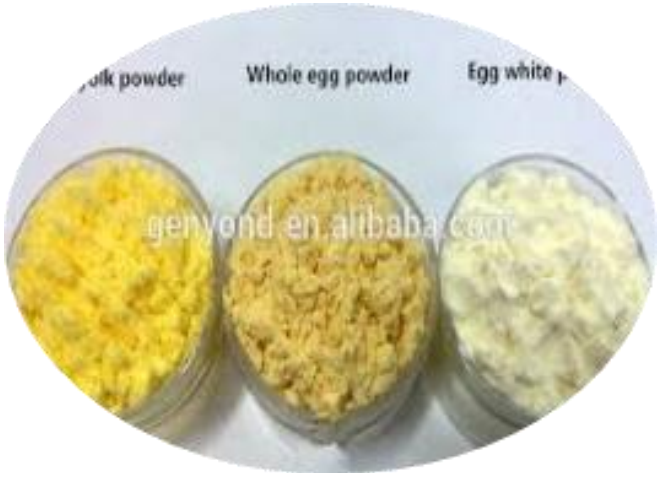


**Figure 7.** Different type of egg powder.Source: genyond.en.alibaba.com.

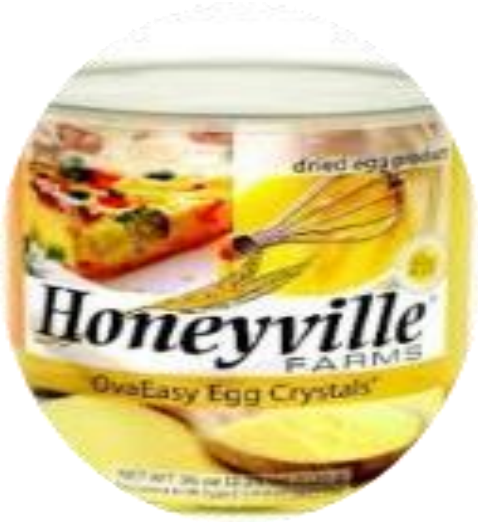


**Figure 8a.** Dehydrated (dried) egg Source: amazon.com.

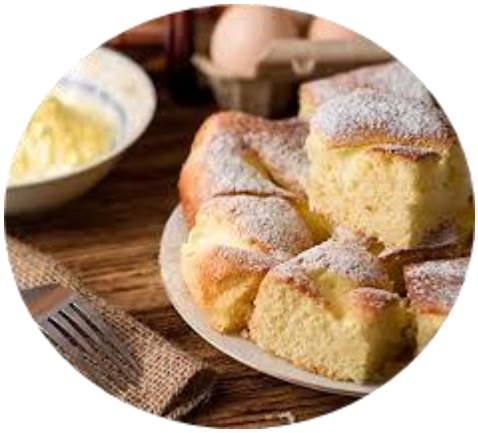

**Figure 8b.** Dehydrated (dried) egg. Source:binge.ae.

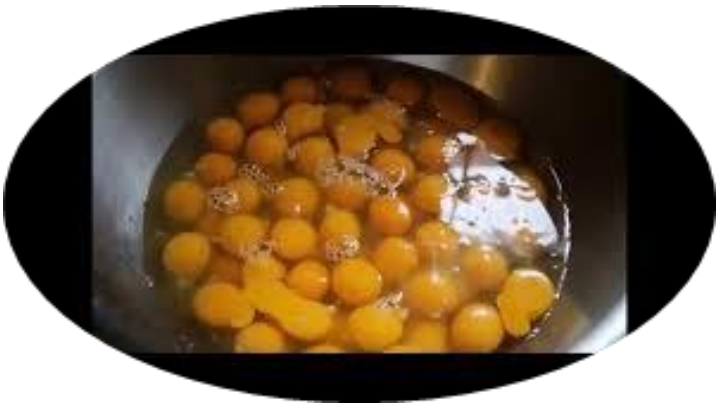

**Figure 9.** Frozen egg. source: youtube.com.

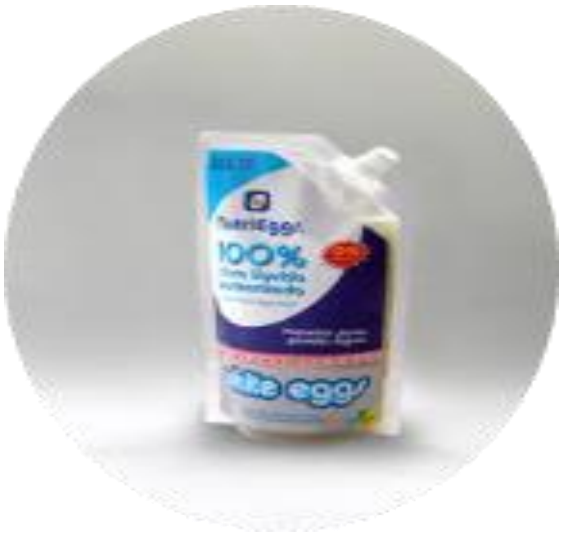


**Figure 10a.** Pasteurized egg Source:en.wikipedia.com.

**Frozen Egg**

Whole egg, yolk egg or white can be frozen. Egg contents are fast frozen in a blast freezer at between -29°C and -35°C. The holding temperature is usually -18°C. Freezing has no effect on egg white on functional and physical characteristics of the whole egg. Plain yolk cannot be frozen as it forms a gel due to increase in viscosity outside but can be frozen with salt and sugar up to 10% as shown in Figure 9.

**Pasteurized Egg**

Pasteurization is the application of heat to egg contents at specific temperature and time to kill micro-organisms which will otherwise cause spoilage of liquid products in storage or in transit to the processing plant. Care should be taken not to destroy the protein by overheating but only micro-organisms as shown in Figures 10a and 10b.

**METHODS OF COOKING EGGS**

Eggs are cooked to kill micro-organisms, for example, salmonella, improve the eggs' shelf life and taste (Abeyrathne et al., 2013). Methods employed are:

***Boiling of Egg***

Whole eggs are placed in a pot with water so that water covers the egg. It is heated to boiling point for 4 to 6 min to produce soft boiled eggs. If it's cooked for 15 to 20 min, it's a hard-boiled egg. The boiled eggs are cooled in

**Figure 10b.** Pasteurized egg.Source:the pioneerwoman.com.

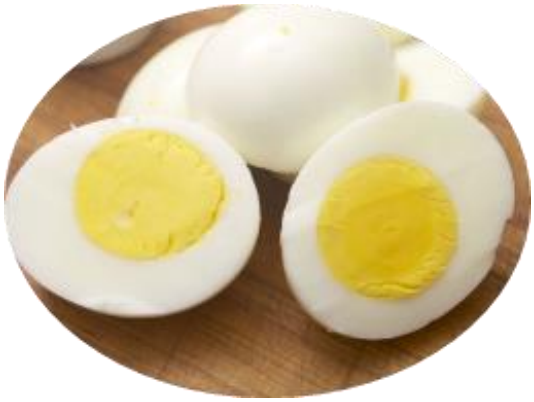

**Figure 11.** Boiled eggs. source: seriouseats.com.

cold water immediately. Quick cooling makes the shell easier to pill and helps to prevent a dark colour from forming around the yolk as shown in Figure 11.

***Frying of Egg***

Fried eggs are produced by frying the whole egg. It's done by removing the shell and pouring the content inside the oil at boiling point. And the egg white surrounds the yolk as can be seen in Figure 12.

***Poaching of Egg***

Poached eggs are produced by boiling whole egg content in the shallow boiling water. The egg white coagulates around the yolk which is in the centre. The egg could be cooked for 2 to 5 min if desired, egg poach in milk as can be seen in Figure 13.

***Scrambling of Egg***

Scrambled eggs are produced when egg contents are stirred together and fried into oil. Milk, cream or water could be added at the rate of 1 tablespoon per egg. Vegetables like tomatoes and onions could also be added. The egg is cooked for 3 to 5 min as shown in Figure 14.

***Omelette Eggs***

Here the egg white and yolk are well blended and fried in a thin layer of oil. Water, milk and cream are not added. The heating is for 2 to 3 min and margarine or butter can be added as shown in Figure 15.

***Baking of Egg***

Baked eggs are produced by baking one whole egg into oil or butter and baking in an oven (Abeyrathne et al., 2013). The egg is put and covered in an oven at 161°C for 15 to 20 min as shown in Figure 16.

***Uses of Eggs and Egg Products***

Eggs have a variety of uses apart from household consumption. It is used in the preparation of chicken burger, scotch eggs, salad, baked foods, hair shampoo, ice creams, custard, beverages, snacks and cakes

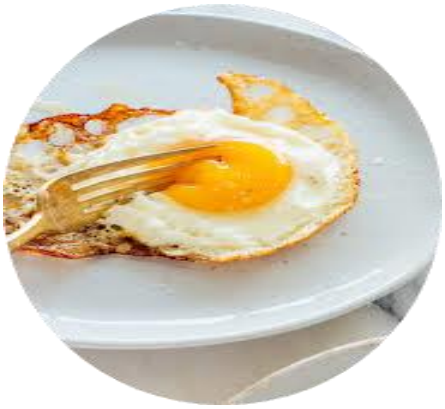

**Figure 12.** Fried eggs.Source: cokieandkate.com.

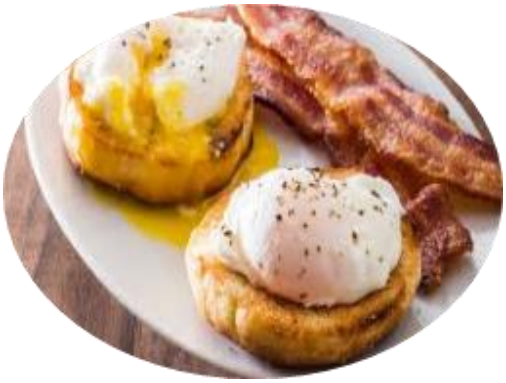

**Figure 13.** Poached egg. Source: splendidtable.org.

**Figure 14.** Scrambled egg.Source: foodnetwork.com.

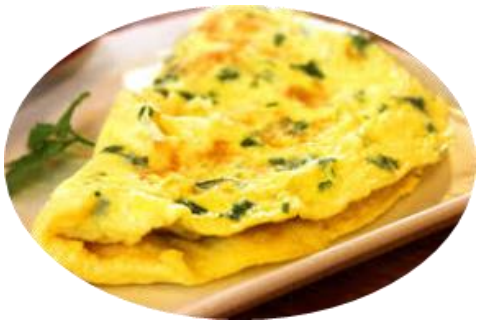

**Figure 15.** Omelette eggs. source: msmarket.coop.

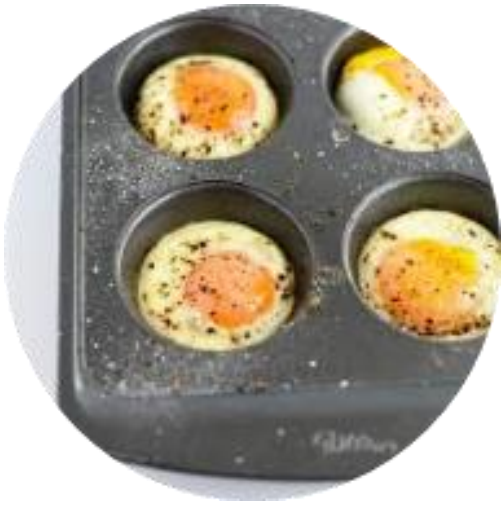

**Figure 16.** Baked egg.Source: fitfoodiefinds.com.

(FOSFAO, 2013). Eggs also have many functional properties such as foaming, emulsifying, and unique color and flavor, which are important in several food products (Abeyrathne et al., 2013).

## CONCLUSION AND RECOMMENDATIONS

For maximum utilization of eggs in Nigeria, eggs can be processed into powder, dried eggs, frozen eggs, salted yolk, sugared yolk, pasteurized eggs, cooked yolk and be included into other food products for human consumption. Raw eggs have a shorter shelf life of about one month, while powdered and processed eggs can last up to a year. The longer shelf life of eggs means output could be preserved rather than wasted. Famers should adopt the simple spray drying technology to convert eggs into powder and other methods of processing eggs to reduce wastages and improve consumption rate.

There is a lot to be done to help poultry farming in Nigeria especially in the area of processing and utilization, feed or food ingredients and health care delivery. Apart from technical expertise, there should be conscious efforts by all tiers of government to address the problems of poultry farmers. There should be credit facilities for poultry farmers in addition to inputs for the desired impact. There is a need for information sharing and collaboration among poultry farmers in order to overcome their challenges and be successful in business.

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