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Full Length Research paper

Effect of oven drying on the functional and nutritional properties of whole egg and its components

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The effect of oven drying on the functional and nutritional properties of whole egg and its components viz; emulsification capacity and stability, foam capacity and stability, water and oil adsorption capacity, coagulation temperatures, solubility and nutritional composition was studied using standard methods. Obtained results showed that egg yolk powder had better emulsification capacity (74%) and stability (72.4%) compared to whole egg (55 and 44.86%) and egg white powder (17.77 and 14.70%). While the egg white powder gave better foam stability (78.3%) and capacity (97.5%) compared to whole egg (59.28 and 40.0%) and egg yolk (28.08 and 38.5%) powders. The coagulation temperatures obtained for egg yolk, egg white and whole egg were 66.5, 63, and 64°C, respectively. The highest solubility was recorded in egg white (96%), followed by whole egg (92%) and egg yolk (88%) powders, while the reverse was the case for the water and oil absorption properties which gave values of 1.6, 0.5, 1.8 and 2.6, 0.6, 0.5 g for the whole egg powder, egg yolk powder and egg white powder, respectively. The total solids were significant in whole egg powder (93.26%), egg yolk powder (96.12%) and egg white powder (95.88%). Obtained results also showed that the nutrient composition of the egg and its components were minimally affected by oven drying at the temperature of study.

Key words: Drying, egg components, functional properties, nutrient composition, coagulation.

INTRODUCTION

Egg is one of the most versatile and near perfect foods in nature. It is 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; Vaclavik and Christian, 2008).

Eggs play important culinary roles and are therefore prepared into different dishes. Their functional properties of emulsification, thickening, foaming and moisturizing help contribute desirable characteristics and physical functions in the industrial production of many food products in which they are incorporated (Desrosier, 1977; Bueschelberger, 2004).

Fresh eggs are however, difficult to transport because of their bulkiness, fragility, and highly perishable nature (Frazier and Westerhoff, 1988; Jay, 2000). Egg in powder form, provides a near complete solution to these problems. The current technological procedures of egg powder production is to wash, break, filter and pasteurize the egg liquid produced, dry them whole or into their various components of egg yolk and egg white. Several processing and preservation methods like spray drying, tray drying and freeze drying techniques have been adopted with repercussions on the qualities of the products (Potter and Hotchkiss, 2006).

This study is therefore aimed at determining the effects of oven drying on the functional and nutritional properties of whole egg and its components.

MATERIALS AND METHODS

Material Preparation and sample analysis

Fresh good quality eggs were obtained from Jothel Poultry Farms, in Kaduna, Nigeria. The eggs were candled to confirm their freshness and were cleaned by dusting, washing and allowed to dry. They were carefully deshelled and separated as egg white liquid, egg yolk liquid and whole egg liquid. These were later homogenized with a metal whisk during which one drop of hydrogen peroxide solution was added to free the products from

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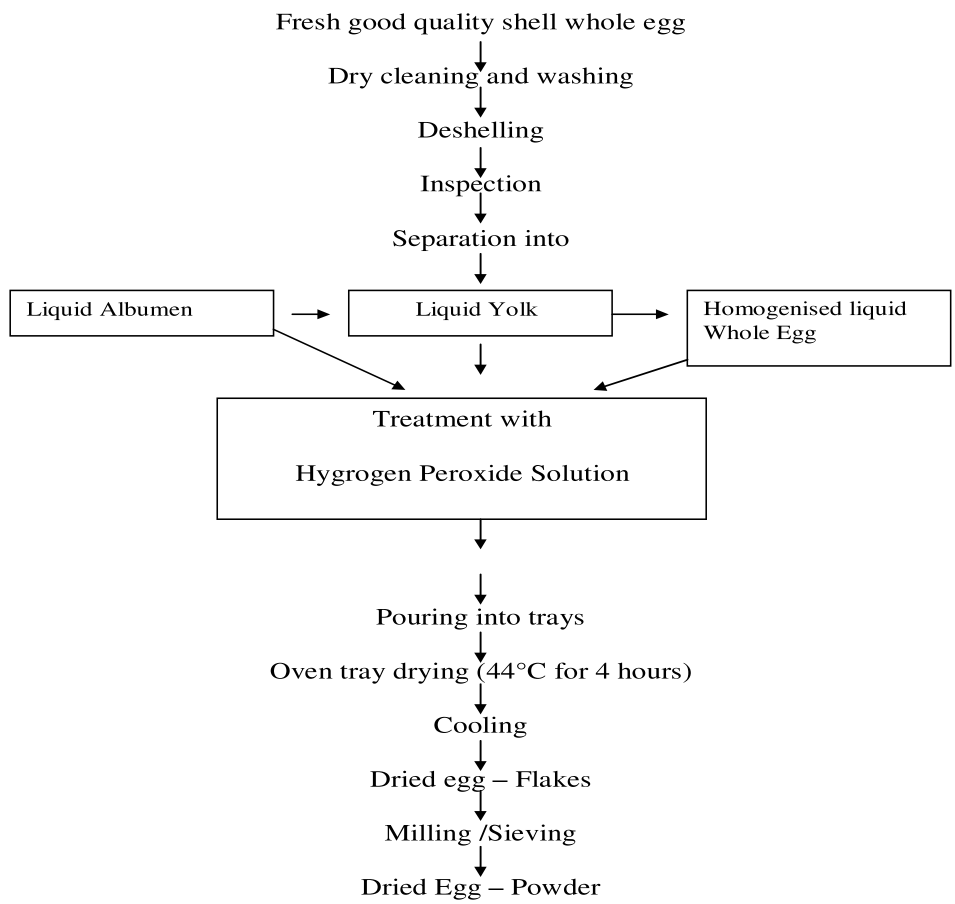

Figure 1. Flow diagram of whole egg processing into powder.

viable *salmonella* microorganism and to prevent browning of the products (Desrosier, 1977). The samples were later oven dried at 44°C for 4 h and allowed to cool. The egg flakes were scooped, milled and sieved with a 60 mm mesh and then weighed. The egg powders (Figure 1) where packed into different plastic films for further investigation.

Determination of nutritional properties

The nutritional quality of egg and its components were assessed using their proximate compositions as a guide.

The AOAC (1990) methods were used in determining the moisture content and fibre content, while the ash content was determined by the furnace method. The crude protein content was determined using Kjeldahl method. That fat content of the sample was determined using ether extraction by reflux soxhlet method, while the carbohydrate was calculated by difference and the gross food energy values (FEV) estimated by the method described by Osuagwu (2008).

Analysis of functional properties

The emulsifying capacities and stabilities were determined using the method of Wang and Kinsella (1976). The foaming capacities and stabilities were determined using the method of Akubor et al. (2000) while the water and oil absorption capacities were determined using the method of AACC (2000) with some modifications. Their solubility indexes and coagulation temperatures were determined using the methods of Adebowale et al. (2008).

RESULTS

The obtained results, indicates that the oven drying method used, had effect on some of the functional properties of the dried egg components (Table 1).

DISCUSSION

Functional properties of foods determine the application and use of such food materials as ingredients for the production of various food products (Yeshajahu, 1991; Wilcox, 2006). The obtained results as shown in Table 1, indicates that the oven drying method used, had effect on some of the functional properties of the dried egg components. The emulsification capacity of 74.00% and stability of 72.40% were highest for egg yolk powder, than for whole egg and egg white powders respectively, the egg white powder gave the lowest values of

Table 1. Functional Properties of Oven dried Whole Egg powder and its components.

Functional properties	Whole egg powder	Egg yolk powder	Egg white powder
Emulsification capacity (%)	55.00	74.00	17.77
Emulsification stability (%)	44.86	72.40	14.70
Emulsification reduction (%)	10.14	1.60	3.07
Foaming capacity (%)	40.00	38.50	28.08
Foaming stability (%)	59.29	28.08	78.30
Water absorption capacity (g)	1.60	0.50	1.80
Oil absorption capacity (g)	2.60	0.60	0.50
Coagulation temperature (℃)	64.0	66.5	63.0
Solubility Index (%)	92.00	88.00	96.00
Total solids (%)	93.26	96.12	95.88

Table 2. Percentage of nutrient contents and food energy value (g/Cal) of whole egg and its components oven dried at. 44℃.

	Protein (%)	Fat (%)	Moisture (%)	Ash (%)	Carbohydrate (%)	FEV (g/Cal)
Whole egg	45.21	8.94	6.74	1.02	38.09	413.66
Egg yolk	26.20	27.62	3.88	0.60	41.70	520.18
Egg white	62.04	7.17	4.32	1.00	25.48	414.52

FEV = Food Energy Value.

17.77 and 14.70%. These values were higher than the values obtained from spray dried egg by Ayo and Okoliko (1999). The low temperature of 44℃ employed during oven drying may have played a significant role. The emulsification properties of food materials are necessary for the stability of the suspension of one liquid in another. Both proteins and lipids (Lecithin) found mostly in the yolk must have contributed to the higher emulsification properties (Okezie and Bello, 1988; Bueschelberger, 2004). These properties are useful in foods such as shortened cakes and mayonnaise.

The foaming capacities and stabilities were highest in egg white powder at 97.50 and 78.30% followed by whole egg powder and least in egg yolk powder of 38.5 and 28.08%. The fat content of these components must have played a significant role in this. For example, while Lipids are known to enhance the emulsification process in foods, they diminish their foaming potentials (Marques, 2000). The foaming properties are particularly important in the stability of ice cream and in bread production (Albert, 1997; Wilcox, 2006).

Water and oil absorption values also varied based on different constituent of each of them, with the whole egg powders recording the highest values of 1.60 and 2.60 g; egg yolk powder(0.50 and 0.60 g) and egg white powder (1.80 and 0.50 g), respectively. These properties exert some useful influence on the rheological, functional and baking qualities of their products (Ihekoronye and Ngoddy, 1982; Manay and Shadaksharaswamy, 2005). The oil and water absorption properties of the eggs also help to retain moisture and oil during baking and subsequent storage. It enhances both the physical and sensory qualities of their products (Potter and Hotchkiss, 2006).

The solubility index, which is one of the physical properties of the protein, showed high values of 96.00% for egg white powder, 92.00% for whole egg powder and 88.00% for egg yolk powder, respectively, thus indicating the low levels of protein denaturation (Wong and Kitts, 2003). The optimal temperature of 44℃ (Table 2) used in this oven drying did not seriously impact negatively on the solubility index and their suitability as functional ingredients.

The oven drying method employed did not significantly affect the coagulation temperatures which were 64.0, 66.5 and 63.0℃ for whole egg, egg yolk and egg white powders, respectively. Therefore, they could be used as binding and thickening agents in food preparations such as sauces, puddings and custard.

Nutritional composition

The nutritional composition determined, showed high values when compared to that of fresh eggs. This is an indication that the drying temperature of 44℃ did not adversely affect the nutritional value of the oven dried egg components.

The moisture contents are low enough to extend the shelf life of the egg powders in an environment of low humidity (Jay, 2000). The high food energy value (FEV) recorded, particularly in egg yolk powder (520.18 g) makes it particularly attractive for infant food formulae (Krause and Maham, 1984; Vaclavik and Christain, 2008).

Conclusion

This study showed that the whole egg powder, egg yolk powder and egg white powder can be produced using the oven drying method, at controlled temperature of 44℃ without adversely affecting their functional and nutritional properties. Hence they could be incorporated as nutritive ingredients in the production of healthy food products.

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