EFFECT OF PROCESSING TECHNIQUES ON MINERAL COMPOSITION OF WHOLE EGG POWDER DERIVED FROM DIFFERENT CHICKEN BREEDS

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ABSTRACT

Egg is a nutrient dense food. The cyclical egg glut characterized by egg spoilage, quality deterioration and wastage impart negatively on poultry farmers. Powdered dried egg provides a convenient alternative to this problem. This study was aimed to evaluate egg powder from ISA Brown (T1), Local chicken (T2) and Noiler (T3) using Spray Dried (SDWEP), Freeze Dried (FDWEP) and Dehydrator Dried (DDWEP) methods. A total of 720 eggs were obtained from T1, T2 and T3, comprising of 240 eggs from each of the breed 30 eggs of each breed were used for SDWEP, DDWEP and SDWEP where 10 eggs were used for each of the method. The process was replicated eight times at two weeks interval using 3x3 Factorial Experiment of RCBD. Data obtained from mineral analysis was analysed using one-way ANOVA statistical model. Means were separated using LSD. Results showed that higher value of crude protein was obtained from DDWEP (50.67%), while least value was obtained in SDWEP (48.97%). T3 had higher values in phosphorus (92.28mg/100g) and potassium (123.6mg/100g). Calcium (33.5mg/100g)). It is concluded that Spray drying and Dehydrator drying for egg powder production stands out for having the highest concentrations of key minerals and can be adopted by home users as much as producers.

Keywords: Mineral Composition, Poultry Breeds, Processing Techniques, Whole Egg Powder.

INTRODUCTION

Livestock farmers have witnessed a steady increase in livestock production with particular reference to poultry (Alice, 2020). The production of poultry products has been on the increase but this seem not to be felt in economic terms amongst most of the farmers (Salami *et al.,* 2021). Among the various components of animal husbandry, poultry farming is the most popular and probably lucrative (Crisan *et al.,* 2022).

In various food industries, eggs are broadly used as ingredients for the preparations of egg recipe food products. Particularly, egg yolk is indubitably an efficient ingredient in many food products for its functional, nutritional, and organoleptic properties (Anton, 2013). Poultry farmers across the nation have cried out that the glut being experienced was likely to discourage farmers from further production and cause a collapse in the poultry sector. The situation has not changed even as at today (Okojie, 2017). Seasonality in egg production patterns, outbreaks of diseases, changes in citizen eating patterns, holidays and rites, and other variables all contribute to the egg glut observed in Nigeria (Alabi, 2020; Nonye, 2022). However, with the advancement in technology and contemporary food processing methods, poultry eggs may now be powdered, which offers several advantages, including easier dosage for the use of eggs as ingredients in mixed dishes and food formulation, easy for transport and storage, and making safe against microbial growth (Bergquist *et al.,* 1995; Alabi, 2020).

MATERIALS AND METHODS

Experimental Site

The study was conducted at Ilham Integrated Farms Birshin Fulani, which is located at 1km along Dass Road, opposite Federal Polytechnic Bauchi, Bauchi State. Bauchi is located in North-Eastern part of Nigeria and is the capital city of Bauchi State. The state with an estimated population of 8,308,800, it is located on the geographical co-ordinate between latitude of $10^0$18'3.47N and longitude $90^0$31E (BAWA, 2023). With an average temperature of 12-18^{0}C minimum and 30-40^{0}C maximum and relative humidity of 16.5% minimum and 66.5% maximum. Bauchi state's estimated annual rainfall varies significantly across different regions. In the south, the rainfall can be as high as 1,300 mm (51 inches) per annum, while in the extreme north, it's significantly lower at 700 mm (28 inches) per annum. This disparity is due to the state's location in two distinctive vegetation zones: The Sudan savannah and the Sahel savannah (NRWSAPSN, 2022). Over 70% of the state population engage in farming, livestock and subsistence agriculture. The environment is conducive to keep different species of livestock such as cattle, sheep, goats, rabbit, donkeys and poultry (BAWA, 2023).

Source of the Experimental Birds / Eggs

The eggs were sourced from Ilham Integrated Farms Birshin Fulani located at 1km along Dass Road, opposite Federal Polytechnic Bauchi, Bauchi State. Eggs of ISA Brown, Noiler and local chicken obtained from Ilham integrated Farms.

Experimental Birds / Design

Three treatments comprising of ISA Brown, Local Chicken and Noiler eggs represented as T1, T2 and T3, respectively was used for the study. A total of 720 eggs obtained from ISA Brown, local chicken and Noiler, comprising of 240 eggs from each of the species. Thirty (30) eggs of each specie was used for freeze drying, Dehydrator drying and air-drying methods, where 10 eggs were used for each of the method. The process was replicated eight times at two weeks interval. The design of the experiment is 3 × 3 factorial experiment in a randomized complete block design (RCBD). **Production and evaluation of differently processed whole egg powders**

Egg powder production

Three processing methods (Freeze dried, Dehydrator and Spray dried) were employed in making the whole egg powder from fresh eggs in the laboratory.

Freeze drying method

Fresh eggs were collected and washed with warm clean water to remove poultry debris and neatly unshelled, poured and whisked thoroughly with the aid of a Sonik Japan Model, SB-1515 blender to ensure albumen-yolk homogenization. The mixture was placed in a SB4L Freeze dryer set at -40°C and left to dry for 48 hours. After drying, the eggs which appeared in a dried-crumbled form was blended with a dry Sonik Japan Model, SB-1515 blender set at 'max' for 30 seconds to get the egg powder product (Bergquist *et al.,* 1995). The whole egg powder was packed and stored in Ziploc bags of 3 X 6" dimension and subjected to Nutrient, mineral, microbial and functional analyses.

Dehydrator drying method

Fresh eggs were collected and washed with warm clean water to remove poultry debris and neatly unshelled and whisked thoroughly with the aid of a Sonik Japan Model, SB-1515 blender to ensure albumen-yolk homogenization. Thereafter the egg slurry was poured into a fruit-roll sheet (a tiny non-stick layer attached to the dehydrator) and then the temperature of the dehydrator was set at 145ºF (62.8ºC). The whole egg slurry was allowed to dry for 19 hours until they were completely in brittle form. The dried brittle egg was packed and poured into a dry Sonik Japan Model, SB-1515 blender set at 'max' for 30 seconds and blended into powder. The whole egg powder was packed and stored in Ziploc bags of 3 X 6" dimension (Bergquist *et al.,* 1995) and subjected to mineral analysis.

Spray drying method

Fresh eggs were collected and washed with warm clean water to remove poultry debris and neatly unshelled and whipped up with the aid of a Sonik Japan Model, SB-1515 blender to enhance homogeneity. Thereafter the egg slurry was poured into a tray and allowed it to dry at room temperature (26 ^{0}C) for 72 hours in a very clean environment free from dust and pathogenic microorganisms until it is completely in brittle form. The dried brittle egg was packed and poured into Ziploc bags of 3 X 6" dimension and subjected to mineral analysis.

Mineral Analysis

Concentrations of minerals (P, Ca, K, Mg and Fe) after digestion were analyzed using atomic absorption spectrophotometer (AAS).

Statistical Analysis

Data obtained from mineral analysis were analyzed using one-way ANOVA statistical model. Means were separated using LSD (SAS 1999-2000).

Results and Discussion

Mineral composition (%) of differently processed whole-egg powders

Table 1 provides a detailed overview of the mineral composition of differently processed whole egg powders, highlighting the significant differences among the treatments ($P < 0.05$). The Spray-Dried Whole Egg Powder

(SDWEP) stands out for having the highest concentrations of key minerals. Specifically, it contains phosphorus at 93.56 mg per 100 grams and calcium at 34.57 mg per 100 grams, indicating its potential nutritional benefits, particularly for bone health (Moreki *et al.,* 2010).

In contrast, the Dehydrated Dried Whole Egg Powder (DDWEP) demonstrates superior levels of potassium and magnesium. It has a potassium content of 124.0 mg per 100 grams, which is crucial for maintaining proper fluid balance and muscle function, as well as a magnesium level of 9.767 mg per 100 grams, important for muscle and nerve function as well as energy production (Sinivir, 2017).

On the other hand, the Freeze-Dried Whole Egg Powder (FDWEP) exhibits lower mineral values, with phosphorus at 81.16 mg per 100 grams, potassium at 120.2 mg per 100 grams, and magnesium at 9.300 mg per 100 grams. However, it compensates for these lower values by having a higher iron content of 1.250 mg per 100 grams, making it a viable option for those looking to increase their iron intake, which is essential for oxygen transportation in the blood (Belyavin, 2013).

These findings corroborate the research conducted by Essayas *et al*. (2021), which also reported significant differences in both macro and trace minerals across various egg powder processing methods. Furthermore, the phosphorus content of 93.56 mg per 100 grams found in SDWEP aligns with the data published by the USDA (2020), suggesting that different drying and processing methods can significantly impact the stability and availability of minerals in egg products. This information is crucial for consumers and manufacturers alike when considering the nutritional quality of processed egg powders.

Table 1: Mineral composition (%) of differently processed whole-egg powder

Nutrients	FDWEP	DDWEP	SDWEP	P-Value
Phosphorus	$81.160^{c}\pm1.833$	$89.780^{b}\pm0.103$	$93.560^{a}\pm0.019$	<0.001
Calcium	$33.500^{b}\pm0.861$	$30.870^{c}\pm0.017$	$34.570^{a}\pm0.236$	<0.001
Potassium	$120.200^{c}\pm0.714$	$124.000^{a}\pm0.085$	$122.800^{b}\pm0.014$	<0.001
Magnesium	$9.300^{c}\pm0.201$	$9.767^{a}\pm0.103$	$9.633^{b}\pm0.018$	<0.001
Iron	$1.250^{a}\pm0.089$	$1.220^{b}\pm0.108$	$1.117^{c}\pm0.007$	<0.001

^{abc}Means with different superscripts within the same rows differ significantly, SEM= Standard error of mean, FDWEP= Freeze dried whole egg powder, DDWEP= Dehydrator dried whole egg powder, SDWEP = Spray dried whole egg powder.

CONCLUSION AND RECOMMENDATION

Spray drying and Dehydrator drying for egg powder production stands out for having the highest concentrations of key minerals and can be adopted by home users as much as producers.

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