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EFFECT OF PROCESSING TECHNIQUES ON PROXIMATE COMPOSITION OF WHOLE EGG POWDERS DRIVED FROM DIFFERENT POULTRY BREEDS

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Abstract

Egg is a nutrient dense food. The cyclical egg glut characterized by egg spoilage, quality deterioration and wastage imparts negatively on poultry farmers. Powdered dried egg provides a convenient alternative to this problem. This study was aimed to evaluate egg powder from ISA Brawn (T1), Local chicken [redacted]

Keywords: Proximate Composition, Techniques, Egg Powders, Poultry Breeds, Processing

(T2) and Noiler (T3) using Spray Dried (SDWEP), Freeze Dried (FDWEP) and Dehydrator Dried (DDWEP) methods. A total of 720 were eggs obtained from T1, T2 and T3, comprising of 240 eggs from each of the breed 30 eggs of each species was used for SDWEP, DDWEP and SDWEP where 10 eggs

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were used for each of the method. The process were replicated eight times at two weeks interval using 3x3 Factorial design RCBD. Data obtained from proximate composition, mineral analysis, microbial load and functional properties were analyzed using ONE-WAY ANOVA statistical model. Means were separated using LSD (SAS 1999-2000). Data obtained from sensory evaluation were analyzed using Non-parametric method. 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)). SDWEP had higher Non-coliform count (0.43cfu/g) Total-coliform count where negative across all the processing methods. T3 was significantly ($P<0.05$) higher than other treatments. SDWEP and DDWEP for egg powder production are effective and can be adopted by consumers. It is concluded that Production of egg powder with the aid of FDWEP, DDWEP and SDWEP was established.

Introduction

Livestock farmers have witnessed a steady increase in livestock production with particular reference to poultry (Alice, 2020). The production of poultry products have been on the increase but this seem not to be felt in economic terms amongst most of the farmers (Salami, 2021). Among the various components of animal husbandry, poultry farming is the most popular and probably lucrative (Crisan *et al.,* 2022). ISA Brown is a popular breed of chicken known for its high egg laying capacity and efficient meat production. It is a cross between Rhode Island Red and Rhode Island white (Tadelle *et al*., 2013). Local chicken (smooth feather) on the other hand are the indigenous or native breeds found in Nigeria, these breeds have developed over time and are typically well adapted to the local environment and specific condition (Kolawole, 2015). Noiler (also called kuroiler) is a breed of chicken developed after crossing a male broiler with an exotic pullet (Egahi *et al*., 2020).

This particular breed of chicken is considered to be dual purpose (egg and meat chicken breed) with sole aim of addressing the challenges of animal food insecurity and to solve problems of financial challenges, especially of rural communities and small holder farmers (Ojedapo *et al*.; 2020).

The ISA Brown layer laid a table egg due to absence of cock, while local chicken and Noiler laid fertile eggs because of their interaction with cocks (Gwaza *et al*., 2016). One of the most important products of the poultry industry is the egg, which is a high-quality source of protein, vitamins and minerals (Agbede, 2019; Asghar and Abbas, 2012). These and other nutrients are required by humans and animals for the construction of body structures, repair of worn-out tissues, growth and reproduction (Réhault-Godbert *et al*., 2019; Chen *et al*., 2018).

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; King'ori, 2012). 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 (Nonye, 2022; Alabi, 2020). 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 (Alabi, 2020; Bergquist, 1995).

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MATERIALS AND METHODS

Experimental Site

The study was conducted at Ilham Integrated Farms Birshin Fulani located at1km 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 (NPC, 2022). It is located on the geographical co-ordinate between latitude of 100°18'3.47N and longitude 90° 31E (BAWA, 2023). With an average temperature of 12-18°C minimum and 30-40°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 was source from Ilham Integrated Farms Birshin Fulani located at1km along Dass Road, opposite Federal Polytechnic Bauchi, Bauchi State. Eggs of ISA Brown, Noiler and local Chicken obtained from Ilham integrated Farms,

was washed with warm clean water to remove Poultry debris and neatly unshelled.

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, 30 eggs of each breed was used for freeze drying, Dehydrator drying and air-drying methods, where 10 eggs was used for each of the method. The process was replicated eight times at two weeks interval and 3x3 Factorial design (RCBD) was used.

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 at Yobe state University Biochemistry laboratory

Freeze drying method

Fresh eggs was 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 would appear 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, 1980). The whole egg powder was packed and stored in Ziploc bags of 3 X 6" dimension and subjected to Nutrient, microbial and functional analyses.

Dehydrator method

Fresh eggs was 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 145°F (62.8°C). 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 1980) and subjected to Nutrient, microbial and functional analyses.

Spray Air dried method

Fresh eggs was 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 °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 a dry Sonik Japan Model, SB-1515 blender set at 'max' for 30 seconds and blended into powder. The whole egg powder was stored in Ziploc bags of 3 X 6" dimension (Bergquist 1980) and subjected to Nutrient, microbial and functional analyses.

3.5 Nutritive Composition Analysis:

The Freeze Drying, Dehydrator and Air-drying whole egg powder samples was analyzed for nutritive composition according to AOAC (2000) as shown in Table 1.

Dry matter (DM)

Moisture content determination was carried out using the air oven method. Crucibles was washed and dried in an oven. They were allowed to cool in the desiccator and the weight was noted. Ten grams (10 g) of the samples was dried

at 60 °C for 3 days. The dried samples was cooled in a desiccator and weighed was later returned to oven and the process continued until constant weights are obtained.

$$\% \text{ DM} = \frac{\text{Weight of sample before drying (g)} - \text{Weight of sample after drying (g)}}{\text{Weight of sample before drying (g)}} \times 100$$

Crude Protein (CP)

The crude protein content was determined using micro Kjeldahl method as described by AOAC, (2000). 0.5 g of sample was weighed into a long necked Kjeldahl flask. One (1) tablet of Kjeldahl catalyst was added to the sample in the flask with 25 $cm^3$of concentrated H_2SO_4. The flask was swirled, gently clamped in an inclined position and heated in a fume cupboard. The heating continued until a clear solution is obtained. The clear solution was cooled, then poured into a 100 cm^3 volumetric flask and made up to mark with the distilled water. 10 ml of the resulting mixture was measured into the distillation set through the funnel. 5cm^3 of boric acid was pipette into a 100 cm^3 conical flask and placed at the receiving end of the distillatory.

The conical flask was placed such that the delivery tube dipped completely into the boric acid inside the flask. 40% NaOH was used to liberate ammonia out of the digest under alkaline condition. During the distillation, 2 drops of methyl orange was added to the round bottom flask containing the digested sample before 40% NaOH was added. As soon as the content become alkaline, the red color changes to yellow showing NaOH to be in excess. Steam will then be generated into the distillation set using a steam chest. The liberated ammonia was trapped in the boric acid solution and about 50 cm^3 of the solution is collected into the conical flask. The solution in the flask was titrated against 0.1 M HCL until the first permanent color change is observed. A blank sample was used in the sample procedure and the titre value for the blank was used to correct the titre for the sample.

Ash Value

One gram (1g) of dried sample was weighed into clean, dried weighed crucibles. The samples were igniting over a low flame to char the organic matter using and electro thermal heat. The crucible will then be placed in muffle furnace at 600 °C for three (3) hours until it turns into ashes completely. The ash samples was then transferred directly to desiccator, cooled and weighed immediately.

$$\% \text{ ash} = \frac{\text{Initial weight (g) – final weight (g)}}{\text{Initial weight (g)}} \times 100$$

Moisture

Principle: The difference in weight after heating the finely minced meat or a ground fish at a particular temperature for a defined duration gives the water content present in the sample. It is represented as g per 100g meat.

Procedure: 20g Feed sample was taken in a clean dry petri dish, kept in an oven at 105° C for 2 hrs, cooled in a desiccator and weighed (W1). About 10-20g portion of meat (W2) was taken in the pre-weighed petri dish, kept in an oven maintained at 105° C overnight. The petri dish was cooled in a desiccator and weighed again (W3). The petri dish was again kept in an oven for half an hour, cooled as above and weighed again to get reproducible weights.

Calculations

Moisture content (%):

$$\frac{W_2 - W_3}{W_2 - W_1}$$

Nitrogen Free Extract (NFE)

The percentage Nitrogen Free Extract was calculated by subtracting 100 from crude protein, ash, moisture and ether extract from 100.

%NFE = 100 – (% crude protein + %ash + % moisture + ether extract)

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RESULTS AND DISCUSSIONS

Proximate Composition of Egg Powders on processing methods

Proximate composition of differently processed, whole egg powders were presented in Table 1. There were significant differences ($P<0.05$) across all the treatments. Higher value of crude protein was obtained from DDWEP (50.67%), while least value was obtained in SDWEP (48.97%). SDWEP had the higher values in Crude fat (13.26%) and Carbohydrate (3.373%) while FDWEP had higher values in Moisture (2.633%) and Ash (1.073%). The higher crude protein value (50.67%) recorded for DDWEP is a reflection of the higher efficiency of the Dehydrator dryer in drying the liquid egg as against the other methods (Mine, 2007). Woo (2013) reported that the higher crude protein value recorded for the DDWEP is probably a consequence of the higher retention of nutritional properties especially the protein found in Dehydrator drying of food materials. Crude protein and Ash results of FDWEP and DDWEP were similar to result obtained by Esther (2018), Woo and Bhandri (2013) and Mine (2007). Moisture content had similar values with Fallon (2017) and agreed with the result obtained by Asghar (2015) for FDWEP.

Table 1: Proximate composition (%) of differently processed whole -egg powders

Nutrients	FDWEP	DDWEP	SDWEP	P-VALUE
Crude protein	$49.600^{b}\pm0.011$	$50.670^{a}\pm0.009$	$48.970^{c}\pm0.001$	<0.001
Crude fat	$12.800^{b}\pm0.001$	$12.25^{c}\pm0.001$	$13.260^{a}\pm0.019$	<0.001
Moisture	$2.633^{a}\pm0.005$	$2.493^{b}\pm0.008$	$2.000^{c}\pm0.001$	<0.001
Ash	$1.073^{a}\pm0.001$	$0.967^{c}\pm0.013$	$1.050^{b}\pm0.044$	<0.001
Carbohydrate	$2.150^{b}\pm0.006$	$2.150^{b}\pm0.013$	$3.373^{a}\pm0.004$	<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.

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Proximate composition of different Breeds of chicken egg powders

Table 2. Shows the proximate composition of differently processed, whole egg powders from different breeds of chicken. There were significant differences ($P<0.05$) across all the treatments. T1 was recorded with higher values in all the parameters except in Ash with T3 having the higher value (1.113%). T2 had the lowest values across all the treatment. Crude protein value (51.13%) recorded for T1 commercial layer egg is a probably reflection of the higher efficiency of the feed given to them as well as the system of management as against the other breeds (Guo, 2016). The moisture content for T1 is in line with result obtained by Wong (2018). Crude protein and Ash results of FDWEP and DDWEP had similar values as obtained by Esther (2018), Woo and Bhandri (2013) and Mine (2007). Carbohydrate had similar results as reported by Fallon (2017).

Table 2: Proximate composition (%) of different Breeds of chicken egg powders

Nutrients	T_1	T_2	T_3	P-VALUE
Crude protein	$51.130^{a}\pm0.581$	$48.600^{c}\pm0.469$	$49.50^{b}\pm0.012$	<0.001
Crude fat	$13.570^{a}\pm0.177$	$11.940^{c}\pm0.493$	$12.790^{b}\pm0.012$	<0.001
Moisture	$2.733^{a}\pm0.108$	$2.027^{c}\pm0.266$	$2.367^{b}\pm0.104$	<0.001
Ash	$1.057^{b}\pm0.151$	$0.920^{c}\pm0.711$	$1.113^{a}\pm0.006$	<0.001
Carbohydrate	$2.730^{a}\pm0.001$	$2.450^{c}\pm0.001$	$2.493^{b}\pm0.001$	<0.001

^{abc}Means with different superscripts within the same rows differ significantly, SEM= Standard error of mean, T_1= Isa Brawn, T_2=Local Chicken, T_3 = Noiler.

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