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FUNCTIONAL PROPERTIES OF POWDERED AND FRESH EGG ALBUMIN AND YOLK DETERMINATION

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ABSTRACT

The study was carried out to evaluate the functional properties of fresh and powdered egg albumin and yolk. The experiment was carried out at Animal Product and Processing lab of the Department of Animal Science, Federal University Dutsinma. Fresh eggs were collect from the Departmental farm. Ten (10eggs) each were weighed and crushed into stainless dish and separated into albumin and yolk for sun drying. After 8 hours of sun drying the crystals were convert into powder form using grinding and sieving techniques. Samples of the powder albumen and yolk were then subjected to functional properties determination. Data collected were analyzed using Statistical Analysis System (SAS) version…2002. The result indicates that there is significant ($P<0.05$) differences in functional properties of both fresh and powdered Albumin. Egg white (Albumin) fresh had Foaming capacity and Foaming stability values of 20.00% and 9.66% while egg white (Albumin) powdered Foaming capacity and Foaming stability had a lesser values of 11.00 % and 2.33% respectively. The Emulsification capacity (EC) and Emulsification Stability (ES) of Fresh Albumin seems to differ having a lower value ($P<0.05$) functional properties of 7.00% and 2.66%, while the Emulsification capacity (EC) and Emulsification Stability (ES) of powdered Albumin had higher value ($P<0.05$) of 35.66% and 4.00%. Similarly the Water Absorption Capacity (WAC) and Swelling Capacity (SC) for Fresh Albumin have a lower value ($P<0.05$) of 1.00% and 2.00%, while the Water Absorption Capacity (WAC) and Swelling Capacity (SC) of powdered Albumin had higher value ($P<0.01$) of 7.00% and 4.00%. The function properties of both fresh and powdered albumin(egg white) and Yolk are mostly similar hence both can be tested for same functional utilization and acceptability in product production and further research should be carried out on the influence of heat on the albumin and yolk nutritional content.

Keywords: Sun drying, Powdered, Fresh Egg, Albumin, Yolk, Whole egg.

INTRODUCTION

Eggs are product of the female specie of different animals including birds, reptiles, amphibians and fish but the most consumed egg by humans is from the chicken. Whole eggs are basic food material that is always in demand and consumed world-wide (Fisinin *et al*., 2008). Eggs are effective animal proteins with a potential to contribute to food and nutrition security and generate household livelihoods (Lannotti *et al.,* 2004), which has a considerable place in food industry. Eggs from chicken species provide a balance source of nutrients as it is cheap, affordable and also acceptable. It has characteristics that make it valuable foodstuff as they are highly nutritive and are excellent sources of animal protein for the populace. Egg products include hard-cooked chopped eggs, precooked scrambled eggs or omelettes, quiches, precooked egg patties, Scrambled egg mixes crepes (Froming, 2008) and egg powder. In the United State of America, about 30% of eggs are processed into various egg products (i.e. liquid frozen, and dried egg products) for use in the food service industry or as ingredients in various food applications. Comparative advantages egg power has over fresh eggs include a longer shelf-life, easy transportation, fresh whole eggs are however, difficult to transport because of their bulkiness, fragility and highly perishable nature (Frazier and Westerhoff, 1988; Jay, 2000). Development and research in food diversity brings to light the importance of food ingredients especially powered food. At the industrial level, eggs are preserved by processing them through spray drying into egg powder (Dixit *et al.,* 2010; Kumaravel *et al.,* 2012; Rannou *et al.,* 2013). The production of dried foods has been on the increase in recent years. Production of dried powdered product is an important sector for the development of the egg market. In Nigeria, it is estimated that more than 90% of the populace live below the poverty level or less than a Dollar per day (Elments Communication, 2007) with few people consuming eggs or egg products. In Nigeria there is a cyclical egg glut in some areas, which might be on the increase as more individuals embark on poultry production in order to alleviate poverty and unemployment. This cyclical egg glut spans for a minimum of 4-5 months per year with several factors such as poor education, low personal income, and availability of complimentary and or substitution foods fingered as possible contributions to egg gluts. The aim of this study is to determine the functional properties of egg yolk and albumin.

MATERIALS AND METHODS

The experiment was carried out at Animal Science Product and Sensory Laboratory, Department of Animal Science, Federal University Dutsin-Ma. Dutsin-Ma is located in the North-western Nigeria. Latitude 12°27`18` North and 7°29`29` East and 605 meters above sea level with an average rainfall of 750mm (Abaje *et al.*, 2014).

Data collection

Egg powder was made using Sun techniques. Freshly laid egg 3hours of laid were collected from the Departmental farm. Samples of 10eggs each were weighed and crushed into stainless dish and separated into albumin and yolk for sun drying. After 8 hoursof sun dryingthe crystals were grinded into powder with laboratory gridding machine as adopted from to Ugwu (2009).Samples of sun dried egg albumin and egg yolk where weigh and determine using digital scale and that of the Fresh egg was also weighed to have an equivalent samples for the determination of the functional properties of both fresh and powdered egg albumin and yolk samples.

Determination of Functional properties

The emulsifying activity (EA) and stabilities (ES) was determined according to the method of Yasumatsu*et al.* (1972), 1g sample, 10ml distilled water and 10ml soyabean oil was prepared in calibrated centrifuge tube. The emulsion was centrifuged at 2000xg for 5min. the ratio of the height of the mixture were calculated as emulsion activity in percentage. The contained calibrated centrifuged tube at 80^{o}C for 30min in a water-bath, cooling for 15min under running tap water and centrifuging at 200xg for 15min. the emulsion stability expressed as percentage was calculated as the ratio of the height of emulsified layer to the total height of the mixture. Foaming Capacities (FC) and Stabilities (FS) using the method of Coffman and Garcia (1997); Narayanaand Narsinga, (1984) was determine as described with slight modification. 1g powdered egg sample was added to 50ml distilled water at 30±2 ^{o}C in a graduated cylinder. The suspension was mixed and shaken for 5min to foam. The volume foam at 30s after whipping will be expressed as foam capacity using the formula:

Foaming Capacity= Volume of foam AW-Volume of foam BW/Volume of foam BW

Where, AW= after whipping, BW= before whipping.

The volume of foam was recorded 1hour after whipping to determine foam stability as per percent of initial foam volume. The water absorption capacity (WAC) and oil absorption capacities (OAC) was determined using the method of Sosulki *et al.,* (1976). WAC was determine by 1g of sample mixed with 10ml distilled water and allow to stand at ambient temperature (30±2^{o}C) for 30min, the centrifuged for 30min at 3000rpm or 2000xg. Water absorption was examined as per cent water bound per gram powdered egg. While oil absorption capacity was also determine by 1g of sample mix with 10ml soyabean oil (Specific gravity: 0.9092) and allow to stand at ambient temperature (30±2^{o}C) for 30min, the centrifuged for 30min at 300rpm or 200xg. Oil absorption was examine as percent oil bound per gram powdered egg. Swelling capacity (SC) were determined by method described by Coffman and Garcia, (1997); Okaka and Potter (1977) method were 100ml graduated cylinder was filled with the sample to 10ml mark. The distilled water was added to give a total volume of 50ml. the top of the graduated cylinder was tightly covered and mix by inverting the cylinder. The suspension was inverted again after 2min and left to stand for a further 8min. the volume occupied by the sample was taken after the 8thmin. While method outlined by Narayana and Narasinga (1984) was used to determine bulk density.

Data Analysis

Data collected were subjected to analysis of variance using General Linear Model Procedure of SAS (SAS, 2000). Significant means were compared using Duncan Multiple Range Test (DMRT 1955).

RESULTS AND DISCUSSION

Functional properties of fresh and powdered Albumin white

The functional properties of fresh and powdered Albumin (Egg white) are presented in table 1.The results shows that significant difference was observed across all the functional properties of both fresh and powdered egg white (albumin). The result revealed that Fresh albumen had the higher (P>0.05) functional properties in terms of Foaming capacity and Foaming stability values of 20.00% and 9.66% respectively while egg white (Albumin) powdered Foaming capacity and Foaming stability had a lesser value of 11.00 % and 2.33% which may be as a result of water lost during the drying process of the egg into powdered and loss of it stability shape or form from liquid to powder. Also the inability of the powder to mixed appropriately with water during the reconstitution of the powder back to liquid another kind of change in state of matter. It's a well-known fact that liquid mixed better with liquids of the same chemical properties than solid that is powder with liquid of the same chemical properties. Although this contradict the findings of (Ndife *et al.,* 2010) who reported 40.00% for FC and FS fresh Albumin and 59.29% for powdered albumin FC and FS respectively. EC and ES of Fresh Albumin seems to differ having a lower value (P<0.05) functional properties of 7.00% and 2.66%, while the EC and ES of powdered Albumin had higher value (P<0.05) of 35.66% and 4.00%. Similarly, the WAC and SC for Fresh Albumin have a lower value (P<0.05) of 1.00% and 2.00%, while the WAC and SC of powdered Albumin had higher value (P<0.05) of 7.00% and 4.00%. This may probably be due to fat content of powdered egg since the fat component of egg was responsible for the low value as lipids are known to enhance emulsification process in foods but they diminish their foaming potential (Marques, 2000) while Emulsification capacities (EC) and Emulsification stability (ES) values are similar with that of Mehm*et al.,* (2010). The better emulsifying capacities and stability observed in this study could be attributed to the processing methods of powdered egg and procedures used for determination of EC and ES. Emulsification capacity is the ability of two liquids to be immiscible. The lower values may be as a result of procedure used in determining functional properties or method used to produce powdered egg. It is the ability for a surfactant to foam an emulsion under a given condition (Pearce *et al.,* 1978). The values obtained for water absorption capacity (WAC) were inconformity with those reported by Abdullahi, (2016). Who reported swelling capacity (SC) of 2.07% for egg powered.it is obvious powder will absorb more water as a result more surface area available within the powder surface area compared to fresh egg where the surface area is already accommodated by the existing natural water in the fresh egg white.

Table 1. The functional properties of fresh and powdered Albumin (Egg white)

Parameters	Fresh	Powdered	SE
FC	20.00a	11.00b	1.73
FS	9.66a	2.33b	0.88
EC	7.00b	35.66a	2.60
ES	2.66b	4.00a	0.33
WAC	1.00b	7.00a	0.57
SC	2.00b	3.33a	0.33

ab= means with different superscript differed significantly,
SE= Standard error, FC= Foaming capacity, FS= Foaming stability, EC= Emulsification capacity, ES= Emulsification stability, WAC= Water absorption capacity, SC= Swelling capacity

Functional properties of fresh and powdered egg yolk

The functional properties of fresh and powdered Egg Yolk are shown in table 2. Forming Capacity (FC), Forming Stability(FS) and Emulsification Stability (ES) fresh yolk has no significant difference from FC, FS and ES powdered egg yolk ($P \leq 0.05$), while Emulsification Capacity (EC), Water Absorption Capacity (WAC) and Swelling Capacity (SC) of fresh and powdered yolk differs ($P<0.05$) significantly. The result revealed that Fresh yolk and powdered yolk had similar functional properties ($P>0.05$) in terms of Foaming capacity, Foaming stability and emulsification stability values of 10.52%, 10.39%, 3.80%, 5.80%, 3.05% and 2.66% respectively. This may be as a result of the content of the yolk which is not the forming type and also the yolk is thicker in liquid form containing more solid than egg white even in the liquid state. The Emulsification capacity (EC), Water absorption capacity (WAC) and Swelling capacity (SC) of powdered yolk differ significantly from that of fresh yolk. Powdered yolk record higher values ($P<0.05$) of EC 51.78%, WAC. 8.7, and SC 3.50% while Fresh yolk recorded lower values ($P>0.05$) of EC 16.04%, WAC 1.66, and SC 2.50% respectively. This may be as a result of the release of water during the drying process allowing the increase in the surface area of the oil in the powdered yolk a form of water displacement with oil. Also This may be as a result of increase in powdered yolk surface area it will absorb more water as well as Swell more while accommodating more water to the surface area just a explained by (Okezie and Bello 1998; Bueschelberger 2004), that heating process of yolk play a great role in stabilizing the suspension of the protein and lipid named (Lecithin) and hence contributing to higher emulsifying properties. This result is also in line with the findings of (Marques, 2000), stating that lipids are known to enhance emulsifying process in food, they diminish the foaming potential. The factors above explain the why higher water and swelling capacity are observed which in line with the findings of (Ihekoronyeand Ngoddy 1982; Manay and Shadaksharaswamy, 2005) stating that the oil and water absorption to retain moisture and oil in storage condition.

Table 2. The functional properties of fresh and powdered Egg Yolk

Parameters	Fresh	Powdered	SE
FC	10.52	10.39	2.43
FS	3.80	5.80	1.32
EC	16.04b	51.78a	2.18
ES	3.05	2.66	0.32
WAC	1.66b	8.72a	0.33
SC	2.50b	3.50a	0.28

ab= means with different superscript differed significantly, SE= Standard error, FC= Foaming capacity, FS= Foaming stability, EC= Emulsification capacity, ES= Emulsification stability, WAC= Water absorption capacity, SC= Swelling capacity.

CONCLUSION AND RECOMMENDATION

The function properties of both fresh and powdered albumin (egg white) and Yolk are mostly similar hence both can be tested for same functional utilization and acceptability in product production. Further research should be carried out on the influence of heat on the albumin and yolk nutritional content.

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