# INFLUENCE OF DIFFERENT PACKAGING MATERIAL ON THE QUALITY ATTRIBUTES OF SUN AND SHADE DRIED EGG POWDER

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**Abstract**

The study was carried out to evaluate the bacterial load count of egg powder produce using shade and sun drying method and stored in 3 packaging materials namely glass bottle, robber and polyethene container. The analysis was carried at Animal science product and processing laboratory of the Department of Animal Science, Faculty of Agriculture, Federal University Dutsin-Ma. The egg powder samples were processed under shade and sun drying methods. A serial dilution using pour plate method was employed. One gram of the sample was mixed with 9 ml of 0.1% distilled water, the sample was shaken thoroughly to make a homogenate solution; this gave the dilution factor of $10^{-1,}$ $10^{-2,}$ $10^{-3}$ respectively The same procedure was carried out on the other treatments then inoculated and incubated at 35$^{o}$c for 48hours which the colony forming unit CFU/g) was counted. The result indicates that the packaging materials allowed continues growth of the bacteria as there is continues increase in the bacterial load counts irrespective of the packing materials. Also shade dried egg powder show the potential of higher level of deterioration at 8week of storage while the sun dried egg powder was still within a countable range in all the packaging material. Egg powder to be stored should be dried effectively so as to completely retard the microbial growth to the berries minimal in egg powder.

KEY words: colony forming unit, sun dried egg powder, shade dried egg powder, containers and bacterial load.

## INTRODUCTION:

Powdered egg comes to existence as a staple of camp cooking as early as 1912. Their ease of storage and nutritional quality were also practical advantages in supplying military troops with what?, and were used in the United Kingdom during World War II for rationing and were known as "Ersatz eggs" during that time (Techer *et al.,* 2014). A lot of finding showed that powdered eggs dates back to the Middle Ages when Chinese used to air dry eggs that had been whipped and left in the sun to dry and then ground. Egg powder has been defined as an eggs that has been dehydrated by using several methods which includes; sun drying, ovum drying, freeze drying, spray drying etc and turned into powdered form (Juliano *et al.,* 2010). The benefits of dehydrated egg products go beyond extending its shelf life. Moisture removal in egg yolk products is important for egg product stability and to reduce costs. Recently, dehydrated egg yolk products have also been used by egg consumers instead of shell egg as raw material because of its longer shelf life, lower transport and storage cost, and specific functional properties (Koç *et al.,* 2011). Dehydrated egg yolk powders serve as raw materials for other products. Recently, there has been an increase in the use of dried egg powders that represents a growing importance of the ready-for-use packages industry (Franke *et al.,* 2002). By reducing the moisture content of egg products, microbial stability is achieved. Moisture is removed by a combination of heat and .mass transfer; the system used to obtain dried egg products determines its quality (Koç *et al.,* 2011). The fact that powdered eggs are a non-perishable food when stored in an airtight container is their greatest advantage. There are several other advantages. You never have to worry about dropping and breaking a dehydrated egg - and dehydrated eggs store in a much smaller space. A dozen fresh eggs take up about 122 cubic inches in their carton. When the eggs are powdered, this is reduced to less than 22 cubic inches per dozen powdered eggs. Not only will this free up room in your refrigerator, a can of powdered eggs requires no refrigeration and stores for months in your pantry. Packaging materials in relation to egg powder materials are basically nothing but airtight containers of mostly bottles or glass in nature, transparent plastic containers, foil papers, polythene backs and lastly any local materials available (Caboni *et al.,* 2005). It is important to note that the selection of a packaging material for a particular food depends not only on its technical suitability that is how well the package protects a food for the required shelf life, it also depends on the availability and cost in a particular area, and any marketing considerations that favour choosing a certain

type of package. Packaging also reduces post-harvest losses, which together with giving access to larger markets, allow producers to increase their incomes. Therefore, adequate packaging in developing countries has profound effects on both the pattern of food consumption and the amount of food consumed (Guo M., 2016). Despite significant of egg powder in food and nutrition. Understanding the shelf in packaging materials will be of significant since packaging plays a larger role in the powders ability to be stored. Hence this study focus on the shelf life of egg powders under 3 packing materials.

*MATERIALS AND METHODS*

The experiment was carried out at Animal science processing Laboratory of the Department of Animal Science and Microbiology laboratory of the Department of Microbiology Federal University Dutsin-Ma. Dutsin-Ma is located in North western Nigeria in latitude $12^0$27''18' North and $7^0$29''29' East and 605 meters above sea level. The average rainfall ranges between 700mm to 900mm occurring annually with distinct wet season between May-September and dry season between October-April (Ati *et al.*, 2019).

**Sample collection**

Two create of fresh eggs was purchased from the Departmental farm of Animal science Federal University Dutsinma. The egg was broken open into a plastic bow were it was whisked for two minute and then transferred into a plan stainless tray for sun drying for 8hours. The crispy was then transferred into a blinder and ground for 30min at the speed of 10,000 revolutions per minute. The powder collected was then pass through a sieve of 1mm and the filtrate was collected for microbial analysis. Same procedure was repeated for the shade drying samples. The samples were collected in three (3) different packaging materials and bacterial load was examined at every two weeks interval for the period of Eight (8) weeks. This medium was prepared by suspending 28g of the powder medium into 1 litre of distilled water. The mixture was dissolved by stirring and finally sterilized by autoclaving at $121^0$C for 1 hour. This was prepared by suspending 65g of the powder into 1 liter of distilled water. The mixture was allowed to soak for 10 minutes, and then swilled to mix thoroughly. It was then sterilized at $115^0$C for 1 hour and cooled at $47^0$C. The enumeration of aerobic mesophillic bacteria of egg powder sample, the serial dilution using pour plate method as described by the American Public Health Association (APHA 1992) was employed. 0ne gram of the sample was mixed with 9 ml of 0.1% distilled water. The sample was shaken thoroughly to make a homogenate solution; this gave the dilution of $10^{-1}$. 1ml of this prepared solution was transferred in to 9ml of the diluents (0.1% distilled water), this gave the dilution of $10^{-2}$. This procedure was repeated to the third dilution which gave the dilution of $10^{-3}$. The dilution bottle was agitated to respond settled materials. 0.5ml of each dilution was then pipetted into separate corresponding petri dishes in duplicates. About 20ml of Nutrient agar (NA) cooled to $45^0$C was poured in to each plate. The sample and the agar medium was mixed by rotating the plate on a flat surface and allow solidifying. The petri dishes was inverted and incubated at $35^0$C for 48 hours. Plates containing bacterial colonies was selected and counted. The number obtained was multiplied by the dilution factor. This gave the number of *bacterial* colony forming unit per gram of the egg powder sample, (CFU/g). All data obtained from the bacterial load counts was analysed using general linear model multivariate procedures of the SPSS version (2021). The means was separated using Turkey Hp.

**Result and Discussion**

The result in Table 1. Indicates the colony forming unit of powdered egg do not differ ($P < 0.05$) across all the packaging material while under storage for week 2.

Table 1. Bacterial count and colony count for sun and shade dried powdered egg packaged with glass container, plastic container and Nylon bag container at week 2

| TREATMENT | SUN C.C DREIED | SHADE C.C DRIED | SUN CFU DRIED | SHADE CFU DRIED |
|---|---|---|---|---|
| Glass container | 2.667 | 3.000 | 34.00 | 310.67 |
| Plastic container | 2.333 | 1.667 | 22.67 | 206.33 |
| Nylon bag | 1.333 | 2.333 | 23.33 | 298.67 |
| S.E | 0.88 | 0.79 | 3.94 | 36.51 |
| OVERALL G.M | 2.111 | 2.333 | 26.67 | 271.67 |
| OVERALL S.E | 0.509 | 0.46 | 2.27 | 21.08 |

*S.E. Standard Error. OM. = Over roll Mean. OSE =Over roll Standard Mean, B.C.C. = Colony Count. C.F.U=Colony forming unit G.B. Glass bottle R.B. Robber bottle L.B= Leather bag.*

The result in Table 1. Shows that there are no difference ($p < 0.05$) across all the packaging materials for both shade dried and sun dried egg powder. This might be true as all the safety procedure as well as hygienic protocol where observed during the production process and both sample where stored under the same environmental condition that may have little or no effect on the packaging materials. The packaging at all level are air tight and do not allow the inflow of air as well as atmospheric moisture or moist air from the storage surroundings. This findings is in line with the research work conducted by Hidalgo, *et al.,* (2004), which stated that the powdered eggs are a non-perishable food when stored in an airtight container is their greatest advantage. Stored in the absence of oxygen and placed in a cool storage environment, powdered eggs have a storage life of 5 to 10 years. This shows that low moisture content and good packaging materials may prevents the growth of microorganisms and reduces further chemical reactions and quality changes such as Millard reaction, carotenoid oxidation, oxysterol formation, lipid oxidation and loss of essential polyunsaturated fatty acids and fat-soluble vitamins, and formation of thiobarbituric acid substances occur or are initiated during spray drying. And on the contrary to the result of Hidalgo *et al*., 2004) and American Egg Board (2017), come up with a possible disadvantage of powder compared with liquid egg is a loss of 'fresh flavour' and a loss of certain functional properties such as aerating power, unless treated with non-reducing sugars prior to either shade, sun or ovum drying. The result in table 2. Indicates the colony forming unit of powdered egg had no significant difference ($P < 0.05$) across all the packaging material while under storage for second week.

Table 2. Bacterial count and colony colony for sun and shade dried powdered egg packaged with glass bottle, robber bottle container and leather bag at week 4.

| **TREATMENTS** | **SUN C.C DREIED** | **SHADE C.C DRIED** | **SUN CFU DRIED** | **SHADE CFU DRIED** |
|---|---|---|---|---|
| Glass container | 36.00 | 309.00 | 72.00 | 651.32 |
| Plastic container | 24.33 | 213.33 | 48.67 | 426.00 |
| Nylon bag | 26.33 | 301.67 | 52.67 | 603.33 |
| S.E | 4.02 | 35.28 | 8.05 | 77.09 |
| OVERALL G.M | 28.89 | 274.67 | 57.78 | 560.27 |
| OVERALL S.E | 2.32 | 20.34 | 4.65 | 44.50 |

*S.E. Standard Error. OM.= Over roll Mean. OSE =Over roll Standard Mean, B.C.C. = Colony Count. C.F.U=Colony forming unit G.B. Glass bottle R.B. Robber bottle L.B= Leather bag.*

The result in table 2. Shows that there are no significant difference ($p < 0.05$) across all the packaging materials for both shade dried and sun dried egg powder. This might also be true indicating the no any form of changes within the samples and the storage is still adequate as seen in week 2 and also the storage environmental condition has not change and as such no effect on the stored powder yet. As long as the packaging material do not allow the powder access to moisture or moist air and it is still air tight bacterial activities is minimize and even deactivated since the conditions are not favourable for it growth and multiplication. The findings is in line with the Caboni *et al,*. (2005), who stated that, for dry whole powder egg product, moisture is removed in sanitized manner reduce microbial activities which result in none contamination 0f the product. Also Koc, *et al,*. (2005) reported that Powdered egg stored in environments with moisture up to 0.577 showed structural changes such as Sticking, collapse, caking, and agglomeration.it has also been reported by Koç *et al.,* (2011), the glass temperature (Tg) of egg powder was reported to be 114 $^0$C, physical properties of powdered egg worsened if processed or stored above this temperature 'and water is responsible for depressing Tg in a food system. According to Corry (2006). The changes occurring in the egg product are affected by the environmental conditions, temperature, moisture, the material used for packaging, and storage time. Also finding contrary to caboni *et al* (2005) stated by .Gherardi *et al.,* (2015). Despite physical barrier and other anti-microbial factors, many microorganisms can invade and cause spoilage of egg products.

The result in table 3. Indicates the colony forming unit of powdered egg had no significant difference ($P < 0.05$) across all the packaging material while under storage for six week (6).

Table 3 Bacterial count and colony count for sun and shade dried powdered egg packaged with glass bottle, robber bottle container and leather bag at week 6

| TREATMENTS | SUN C.C DREIED | SHADE C.C DRIED | SUN CFU DRIED | SHADE CFU DRIED |
|---|---|---|---|---|
| Glass container | 81.00 | 554.00 | 162.00 | 1108.00 |
| Plastic container | 52.33 | 426.67 | 104.67 | 853.33 |
| Nylon bag | 55.00 | 592.00 | 110.00 | 1184.00 |
| S.E | 7.41 | 74.14 | 14.82 | 148.29 |
| OVERALL G.M | 62.78 | 524.22 | 125.56 | 1048.44 |
| OVERALL S.E | 4.28 | 42.81 | 8.56 | 85.61 |

*S.E. Standard Error. OM.=Over roll Mean. OSE =Over roll Standard Mean, B.C.C. = Colony Count.C.F.U=Colony forming unit G.B. Glass bottle R.B. Robber bottle L.B= Leather bag.*

The result in table 4.3. Indicates that the colony forming unit of powdered in both sun and shade dried powder egg had no significant difference ($P < 0.05$) across all the packaging material while under storage for week 6. The production of healthy product and maintenance of good hygienic environment do enhance good and adequate quality production of the powder egg that are safe for human consumption. Also packages are stored under favourable condition that retard microbial growth. This is In-line with the work carried out by De Reu *et al.,* (2009). Who stated that dried egg products are scarcely affected by spoilage because of their low water activity? In dried egg products, spoilage events may occur only in the case of mishandling leading to an increase in the (aw) water activity value.; According to the USA Emergency Supply, powdered eggs are non-perishable when stored in an airtight container, absence of oxygen and placed in a cool storage environment, under these conditions, powdered eggs have a storage life of 5 to 10 years.

The result in table 4. Indicates the colony forming unit of powdered egg had no significant difference ($P < 0.05$) across all the packaging material while under storage for eight (8), weeks

Table 4. Bacterial count and colony count for sun and shade dried powdered egg packaged with glass bottle, robber bottle container and leather bag at week 8.

| TREATMENTS | SUN C.C DREIED | SHADE C.C DRIED | SUN CFU DRIED | SHADE CFU DRIED |
|---|---|---|---|---|
| Glass container | 163.33 | TNC | 326.67 | TNC |
| Plastic container | 107.00 | TNC | 214.00 | TNC |
| Nylon bag | 110.00 | TNC | 220.00 | TNC |
| S.E | 17.86 | TNC | 35.71 | TNC |
| OVERALL G.M | 126.78 | TNC | 253.56 | TNC |
| OVERALL S.E | 10.31 | TNC | 20.62 | TNC |

*S.E. Standard Error. OM. = Over roll Mean. OSE =Over roll Standard Mean, B.C.C. = Colony Count.C.F.U=Colony forming unit G.B. Glass bottle R.B. Robber bottle L.B= Leather bag.*

The result in table 4.4. Shows that there are no significant difference ($p < 0.05$) on sun dry colony count packaging materials. While in shade dried samples the load count are too numerous to count hence the increase observed at the 8 week was beyond acceptable level which does indicate spoilage of the egg powder making the shade dried egg powder unsafe and unfit for human consumption. This is in contrary with findings of Hildalgo *et al,* (2004) which stated that that powdered eggs are a non-perishable food when stored in an airtight container. The shade dried egg powder result shows that the bacteria load count at week 8 was already too numerous to count (TNC) which shows that the level of deterioration is high and the product is no longer safe for consumption at the week eight of storage. This may be attributed to the nature of drying the powder as shade drying processing may be having more moisture than the sun dried egg powder. This is in line with the findings of Sanusi et al., (PhD thesis unpublished 2022) reporting moisture content for shade dried egg powder as 5.76% and sun dried egg powder as 4.46%

which is responsible for increase in the bacteria load count. Also Mendes *et al*., (2012) reported that low moisture content in dried food products can either inhibit lipid oxidation reactions and decreases bacterial activities.

## CONCLUSION AND RECOMMENDATION

The study shows that the three packaging materials has no direct effect on the shelf life of egg powder although there allowed continuous growth of the bacterial. It is also denoted that the egg powder bacterial count continue to appreciate, which is a form of deterioration of the product and hence this powder may not be fit for consumption as the storage continues. Although shade dried egg powder was first to get spoiled under the same packaging materials. Further study should be carried out to characterise the bacterial multiplication and well as the types of bacterial present.

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