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Effect of Wrapping Leaves on Fungal Growth, Proximate Composition and Shelf Life of Solid Pap in Ibadan, Nigeria

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ABSTRACT

Solid pap is a common gel-like traditional fermented food made from maize (*Zea mays*) in Nigeria. Packaging plays a crucial role in preserving food quality by preventing fungal, chemical, or physical deterioration. This study evaluated the impact of different leaves on fungal growth and the proximate composition of pap. Samples were wrapped with Miracle Berry (*Thaumatococcus daniellii*), *Megaphrynium macrostachyum*, Teak (*Tectona grandis*) and Banana leaves (*Musa paradisiaca*). Proximate and fungal analyses were conducted on day 0 and day 4 of storage. Fresh pap had 81.87% moisture, 2.47% ash, 1.20% crude fiber, 0.83% crude fat, 9.68% protein and 18.20% dry matter. Moisture content decreased during storage, with *T. grandis* showing the highest reduction from 81.87% to 0.41%, 82.23% to 23% in *M. macrostachyum* leaf, 84.52% to 1.40% in *M. paradiosiaca* leaf and 82.27% to 0.43% in *T. daniellii* leaf. *T. grandis* wrapped pap also had the highest proximate composition. Fungal species such as *Aspergillus*, *Penicillium notatum*, *Neurospora*, *Rhizopus stolonifera*, and *Fusarium* increased significantly over time. However, pap wrapped in *T. daniellii* was least susceptible to microbial contamination and best preserved the nutrients. The study suggests discouraging the use of *M. macrostachyum*, *M. paradisiaca* and *T. grandis* leaves for wrapping solid pap due to higher susceptibility to fungal contamination which leads to deterioration of quality.

Keywords: Contamination, fungi, maize, solid pap, packaging

INTRODUCTION

Cereals have been known to man from the primitive time, porridge made from cereals are eaten in different parts of the world, especially in developing countries where they are the basic diet of common man(Jonathan,2019). This porridge could be baked to improve the digestibility, value taste, (Akinfemi et,al,.2009;Oke 2020, Adeniyi and Potter 2018, Uno and Field ,2021).

Maize is high yielding, easy to process, readily digested, and cheaper than other cereals (Jonathan,2009). It is also a versatile crop; growing across a range of agro ecological zones (Valencia *et al.*, 2020). It is a cereal crop grown in various agro-ecological zones, as a single crop or in mixed cropping. It is the third most important cereal in the world, next to rice and wheat and with highest production potential among the cereals (Prathyusha *et al*., 2021). It is the most heavily cultivated cereal crop globally, and one of the main cereals crops of West Africa and the most important cereal food in Nigeria (Sobowale *et al* 2007;Onuk*et al*., 2019).

Solid pap is a gel-like traditional fermented starchy food item made in Nigeria from maize, millet and sorghum. It is cream to glossy white from maize, light brown from sorghum and grey to greenish colour from millet, its colour depends on the cereal used. This food had undergone a required change due to the action of the invading fungi or their metabolic products (Jonathan,2019;Patience, 2019). Solid pap is known by different names in different localities such as eko elewe (Yoruba), akasan (Benin), kamu (Hausa) and agidi (Ibo).

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It is a fermented maize, millet or sorghum product obtained as smooth gel, mixed with boilingwater to form a solid pap. These fermented products are largely produced from *Zea mays, Sorghum valgare, Oryza sativa* and *Triticum aestivum*. Similar maize preparations are referred to as "Akana" and "Kenkey" in Ghana. It is a popular staple and most popular a traditional weaning food in West African counties (Adams and Moss, 2021; Amakoromo, 2021).

Solid pap 'eko elewe'is mostly prepared using malting technologies and traditional fermenting which are simple but do not guarantee quality and lack of contaminations as well as lack the appropriate nutritional value (Marero *et al*., 2019). It is prepared by soaking (steeping) in water for two to five days, grinding it (wet milling) and sieved to remove the husk. The main reason for fermenting these grains is to convert starch contents in the cereals such that it does not require dilution. The fermenting process also removes the pathogens.

Packaging which is an integral part of food processing provides the proper environmental conditions for long shelf life. It protects the products against fungal, chemical or physical deterioration (Jonathan *et al* 2018;Komolafe, 2021). Processed foods can be preserved for extended periods by an aseptic packaging to exclude microbes and oxygen as well as to maintain a moderate temperature (Patience, 2019). However Packaging materials have also been known to be possible source of fungal contamination of solid pap (Wasiu *et al*., 2019).

Packaging function as protection, transportation, sales, promotional services and guarantee. Packaging and handling of the products before and during sales to consumers are also source of concern. Like most other ready to eat foods sold on streets, road sides and market places, solid pap 'eko elewe' is prone and subject to contamination (Oranusi and Olorunfemi 2021). Packaging is the science, art and technology of enclosing, sale and use. It is also a means of achieving safe delivery of products in a sound condition to the final user. Some of these packaging materials are plastic, paper, nylon, leaves etc.

The role of packaging in the food industry which includes protection, containments, transportation, preservation and advertisement are not achieved in all of the packaging method used in Nigeria. This in turn results in a huge loss of the food product not only during packaging processes but also during transportation and sales (Enyisi *et al*., 2021). The only regulatory body in Nigeria, "National Agency for Food and Drug Administration Control" (NAFDAC) has made tremendous progress in controlling the safety aspect in some of the food industry in Nigeria, such as in the confectionaries, sachet water industry and pharmaceutical industry. However, little or no efforts are made on the local food product which is the most common in the country (Adegunloye *et al*., 2018).

Packaging materials have been known to be possible source of fungal contamination of food (Faseyi, 2018). It is therefore important that manufacturer and food handlers keep food safe from pathogenic microorganisms (Hicks, 2015) since food eaten has a direct influence on health,

Solid pap is traditionally wrapped with leaves or paper and marketed, it is domestically made and commonly hawked along the streets or displayed in the market (Omosuli *et al.,* 2021).

There is habitually unacceptable high level of hand contact with the foods on display which easily lead to contamination of such goods (WHO, 2015). These wrapping materials are poorly handled and transported. They are often dirty and are kept in the open with little or no provision for washing before use. These may therefore be a source of fungal contamination of the food (Adejumo & Ola, 2018). Over the years few works has been done to try and investigate the effect of the commonly use packaging materials on the nutrient composition and microbial on pap as a general local food especially in Oyo State particular in Ibadan.

These wrapping materials are usually meant for containment within little or no attention paid to the wellbeing of the consumers. The hygienic state of the wrapping materials and its relevance for the food products are not considered in its selection (Adejumo and Ola, 2018). Therefore, there is a need to examine the effect of these wrapping materials on the microbial quality of ready-to-eat solid pap, as most of these vendors exhibit poor hygienic conducts in the storage and handling of wrapping materials.

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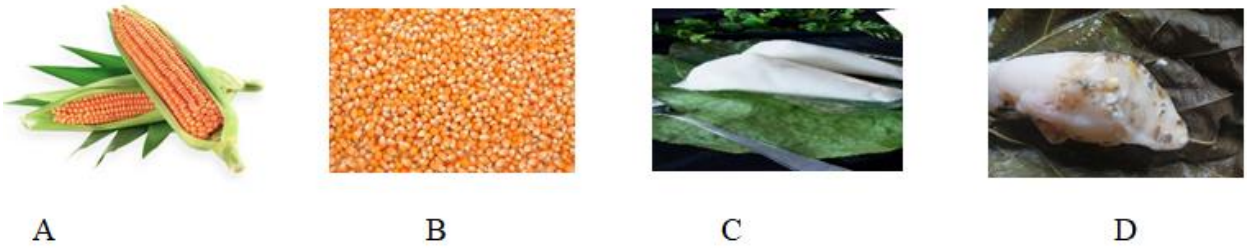
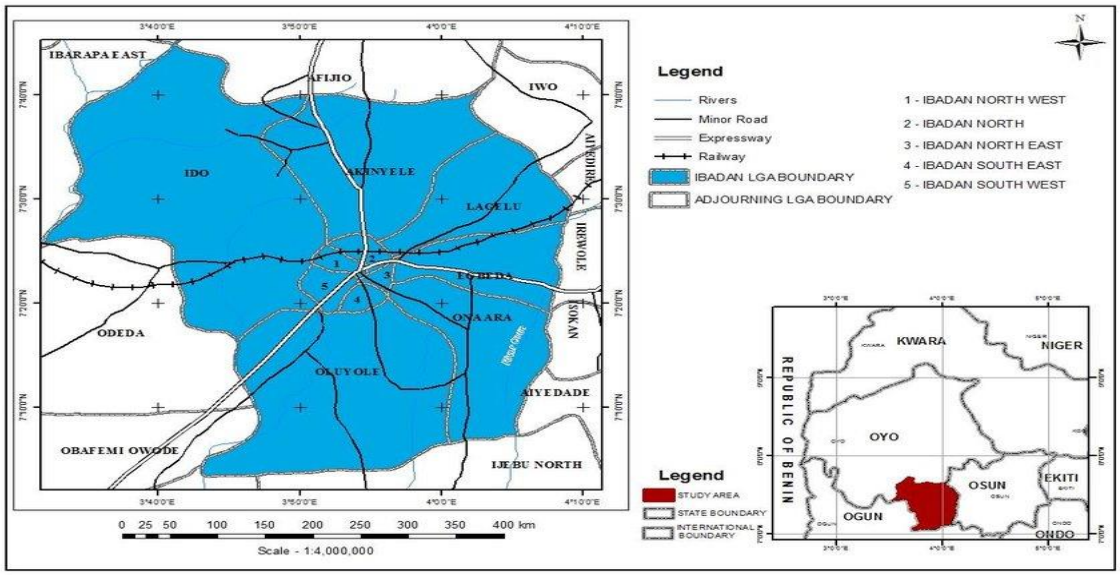


PLATE 1: A. Maize cob B. Maize grain C. Prepared pap D. Fungus infected solid pap

Source: (http://www.coextra.eu/images/image1233.html)

MATERIALS AND METHOD



Map of Ibadan showing description of study area

Source: National Population Commission 1991

Materials and Methods

Collection of Materials

Solid pap and leaves were obtained from Oje, Beere and Agbeni markets in Ibadan, Oyo State, Nigeria

Fungal Isolation

One gram of each of the samples were weighed under sterile condition and mixed with 9ml of sterile distilled water and this was used to prepare dilutions from 10^{-1} to10^{-6}.

Appropriate dilutions were inoculated into sterile petri dishes on which molten potato dextrose agar (PDA) was added. The plates were left to solidify and incubated at 30ºC for 72 hours when the visible growth were observed on the same mycological agar plates. The fungal colonies were sub-cultured on PDA plates to obtain pure culture was obtained (Okpewho,*et al*.,2024) .

Fungal Analyses

Total heterotrophic plate count and total fungi count of each sample were determined using standard pour plate technique (Jonathan,*et.al*,.2023).

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Calculation of Plate Count

The number of total microorganisms per gram of the original sample is obtained by multiplying the number of colonies on the plates by the dilution factor i.e. (n x df). Dilutions which yield fewer than 300 colonies per plate were usually selected. For example, if you counted 200 and 180 colonies on a 10^{-3} dilution plates, it should be averaged to 190 and multiply by the dilution factor of 10^3. Thus, the Total Microbial Count will be 1.90 x10^3 cfu/g (colony forming unit per gram) which has to be expressed in standard form as 1.9 x 10^5 cfu/g (colony forming unit per gram) (Jonathan,*et.al,*.2023).

Identification of Fungi

The pure cultures of various isolated fungi were identified using structural features such as shape, size, colony, colour, extent of growth, presence or absence of mycelia, spores and nature of colony surface. Discrete colonies were counted and reported as fungi count (cfu/g) (Jonathan,*et.al,*.2023)..

Identification of isolates

The cultural, morphological and biochemical characteristics of the respective isolates were compared with the criteria described by Bergey's Manuel of determinative bacteriology (1994).

Relative occurrence = total occurrence of a particular fungal isolate divided by the total number of all isolates, multiplied by 100 and expressed in percentage

Methods of analysis with reference number

Samples were analyzed chemically according to the official methods of analysis described by the Association of Official Analytical Chemist (A.O.A.C. 2023). All analysis were carried out in three replicates.

Crude protein determination

The crude protein in the sample were determined by the routine semi-micro Kjeldahl, procedure/technique (AOAC, 2023). This consisted of three techniques of analysis namely Digestion, Distillation and Titration.

Digestion

Dried sample (0.5g) of each finely ground dried powder was weighed carefully into the Kjeldahl digestion tubes to ensure that all sample materials got to the bottom of the tubes. To this were added 1 Kjeldahl catalyst tablet and 10ml of Conc. H_2SO_4. These were set in the appropriate hole of the Digestion Block Heaters in a fume cupboard. The digestion was left on for 4 hours, after which a clear colourless solution was left in the tube. The digest was cooled and carefully transferred into 100ml volumetric flask, thoroughly rinsing the digestion tube with distilled water and the flask was made up to mark with distilled water(AOAC, 2023)..

Distillation

The distillation was done with Markham Distillation Apparatus which allows volatile substances such as ammonia to be steam distilled with complete collection of the distillate. The apparatus was steamed out for about ten minutes. The steam generator is then removed from the heat source to all the developing vacuum to remove condensed water. The steam generator is then placed on the heat source (i.e., heating mantle) and each component of the apparatus was fixed up appropriately.5ml portion of the digest above was pipetted into the body of the apparatus via the small funnel aperture. To this was added 5ml of 40% (W/V) NaOH through the same opening with the 5ml pipette.The mixture was steam-distilled for 2 minutes into a 50ml conical flask containing 10ml of 2% Boric Acid plus mixed indicator solution placed at the receiving tip of the condenser. The Boric acid plus indicator solution changes colour from red to green showing that all the ammonia liberated have been trapped. (AOAC, 2023).

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Titration

The green colour solution obtained was then titrated against 0.01N HCL contained in a 50ml Burette. At the end point or equivalent point, the green colour turns to wine colour which indicates that all the Nitrogen trapped as Ammonium Borate [$(NH_4)_2BO_3$] have been removed as Ammonium chloride (NH_4Cl).

The percentage nitrogen in this analysis was calculated using the formula:

% N = Titre value x atomic mass of Nitrogen x Normality of HCL used x 4or

% N = Titre value x Normality/Molarity of HCL used x atomic mass of

N x volume of flask containing the digest x $\frac{100}{}$ 1

Weight of sample digested in milligram x Vol. of digest for steam distillation.

The crude protein content is determined by multiplying percentage Nitrogen by a constant factor of 6.25 i.e., % CP = % N x 6.25. (AOAC, 2023).

Crude fat or ether extract determination

Dried sample1.0g) was weighed into fat free extraction thimble and pug lightly with cotton wool. The thimble was placed in the extractor and fitted up with reflux condenser and a 250ml soxhlet flask which has been previously dried in the oven, cooled in the dessicator and weighed. The soxhlet flask is then filled to $^3/_4$ of its volume with petroleum ether (b.pt. 40º – 60ºC), and the soxhlet flask. Extractor plus condenser set was placed on the heater. The heater was put on for six hours with constant running water from the tap for condensation of ether vapour. The set is constantly watched for ether leaks and the heat source is adjusted appropriately for the ether to boil gently. The Ether is left to siphon over several times say over at least 10 – 12 times until it is short of siphoning. It is after this is noticed that any ether content of the extractor is carefully drained into the ether stock bottle. The thimble containing sample was then removed and dried on a clock glass on the bench top. The extractor, flask and condenser were replaced and the distillation continues until the flask is practically dry.

The flask which now contains the fat or oil was detached, its exterior cleaned and dried to a constant weight in the oven. If the initial weight of dry soxhlet flask is Wo and the final weight of oven dried flask + oil/fat is W_1, percentage fat/oil is obtained by the formula:

$$\frac{W_1 - Wo}{\text{Wt. of Sample}} \times \frac{100}{1}$$

(AOAC, 2023).

Dry matter and moisture determination

Two (2..0g) of the sample was weighed into a previously weighed crucible. The crucible plus the sample taken was then transferred into the oven set at 100^0C to dry to a constant weight for 24 hours overnight. At the end of the 24 hours, the crucible plus sample was removed from the oven and transferred to desiccator, cooled for ten minutes and weighed(AOAC, 2023)..

Wo: weight of empty crucible

W_1: weight of crucible plus sample

W_3: weight of crucible plus oven-dried sample

(% DM) % Dry Matter = $\frac{W_3 - Wo}{}$ x $\frac{100}{}$

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$W_1 - Wo \quad 1$

% Moisture = $\frac{W_1 - W_3}{W_1 - Wo} \times \frac{100}{1}$

or % Moisture = 100 – % DM.

Determination of ash

Two **(**2.0g) of the sample was weighed into a porcelain crucible. This was transferred into the muffle furnace set at 550ºC and left for about 4 hours. About this time, it had turned to white ash. The crucible and its content were cooled to about 100ºC in air, then room temperature in a dessicator and weighed. This was done in duplicate. The percentage ash was calculated from the formula below:

Ash content = $\frac{\text{weight. of ash}}{\text{original weight of sample}} \times \frac{100}{1}$ (AOAC, 2023).

Fibre determination

:Two (2.0g) of the sample was accurately into the fibre flask and 100ml of 0.255N H_2SO_4 added. The mixture was heated under reflux for 1 hour with the heating mantle. The hot mixture was filtered through a fibre sieve cloth. The filterate obtained was thrown off and the residue was returned to the fibre flask to which 100ml of (0.313N NaOH) was added and heated under reflux for another 1 hour. The mixture was filtered through a fibre sieve cloth and 10ml of acetone added to dissolve any organic constituent. The residue was washed with about 50ml hot water on the sieve cloth before it was finally transferred into the crucible. The crucible and the residue were oven-dried at 105ºC overnight to drive off moisture. The oven-dried crucible containing the residue was cooled in a desiccator and later weighed to obtain the weight W_1. The crucible with weight W_1 was transferred to the muffle furnace for Ashing at 550°C for 4 hours. (AOAC, 2023).

The crucible containing white or grey ash (free of carbonaceous material) was cooled in the dessicator and weight to obtain W_2. The difference $W_1 - W_2$ gives the weight of fibre. The percentage fibre was obtained by the formula:

% Fibre = $\frac{W_1 - W_2}{\text{weight of sample}} \times \frac{100}{}$

Nitrogen-free extract (NFE) determination

The NFE was determined by difference. This was done by subtracting sum of (Moisture % + % Crude Protein + % Ether Extract + % Crude Fibre + % Ash) from 100

(100 – (% M + % CP + % EE + % CF + % Ash). (AOAC, 2023).

RESULTS

Fungal Contamination

A total of four fungi species (*Aspergillus niger, Penicillium notatum, Fusarium sp, Neurospora sp, Rhizopus stolonifer*) were isolated (Table 4.1). The incidence of fungal contamination started from day 0 (freshly prepared pap). At this *Thaumatococcus danielii* leaf (ewe eran*)* had the least fungal population (0.48%) of occurrence, while banana leaf (*Musa paradiosiaca)* had the highest (1.67%). Generally speaking, the occurrence of the fungi isolated was higher in pap wrapped with banana leaf (*Musa paradiosiaca*) throughout the period of storage. The occurrence of these fungi was observed to be significantly ($p \leq 0.05$) increased from

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day 0 to day 4, the end of storage period in both wrapping materials. At the end of storage period *M. macrostachyym* leaf and *Musa paradiosiaca* have the highest fungal population from (1.60%) at day 0 to (5.66%) in day 4and (1.67) in day 0 to (6.67%) in day 4 followed *Thaumatococcus danielii* leaf (1.50%) at day 0 to (3.53%) at day 4 and (0.48%) at day 0 to (1.13%) at day 4

Probable fungi at day 0: *Aspergillus species*, Probable fungi at day*: Penicillium notatum, Neurospora spp, Rhizopus stolonifera and fusarium species*

Table 1: Fungal population in pap samples on the day 0 and 4 using different leaves

Wrapping materials	Total fungi count (cfu/g) x 10^{-2}	
	Day 0	Day 4
Teak leaf (*Tectona grandis)*	1.50^{ab}	3.53^{d}
Banana leaf (*Musa paradiosiaca)*	1.67a	6.67^{a}
Megaphynium macrostachyym leaf	1.60^{a}	5.66^{b}
Thaumatococcus danielii leaf	0.48^{c}	1.13^{c}
HSD	2.04	2.92

Means with same superscript down the column are not significantly different based on Tukey's HSD test at $p \leq 0.05$

Proximate composition of the pap

The results of the percentage proximate composition of the cold pap are presented in Table 4.3 to 4.8. The fresh pap at day 0 was found to contain 81.87 % moisture content, ash 2.47%, crude fat 0.83%, crude fibre 1.20%, crude protein 9.68% and dry matter 18.20%. The proximate composition of the wrapping materials decreased continuously from day 0 to 4of storage. The protein content was found to significantly decreased from day 0 to day 4 (from 9.68% to 6.88% in *Thaumatococcus daniellii* leaf, 8.16%to 5.36% in banana leaf (*Musa paradiosiaca*,) in *Megaphynium macrostachyum* leaf 7.60% to 5.26%, and *Teak* leaf (*Tectona grandis)* leaf 7.97% to 5.72% respectively).

The moisture content decreased with period of storage from day 0 to 4 day. That was from 82.23% to 23% in *M. macrostachyum* leaf and from 81.87% to 0.41% in *T. daniellii* leaf. The decreased in moisture content was significantly different ($p \leq 0.05$) between days 0 and 4 but there was no significant deference at day 4 between *T. danielii (0.41%*) leaf, banana leaf 1.40% (*M. paradiosiaca) and Teak* leaf (*T. grandis)* 0.43% respectively. The dry matter content at day 4 (18.59%) was significantly higher ($p \leq 0.05$) than day 0 in *T. daniellii* leaf and decreased to 16.89% and 17.85% at day 4 in *M. paradiosiaca* leaf and *M. macrostachyum* leaf respectively. The decrease was not significantly different ($p \leq 0.05$) between day 0 and day 4 of storage in both the leaf and nylon. The crude fat was generally low compared to other food constituents. It was 0.83% at day 0 and decreased to 0.28% at day 5 in *T. daniellii* leaf, 0.57% to 0.27% in *M. paradiosiaca* leaf, 0.70% to 0.24% in *M. macrostachyum* leaf and 0.53% to 0.16% in *T. grandis* respectively.

Table 2: Effect of selected wrapping leaves on the crude protein content of pap

Wrapping leaves	% Crude protein	
	Day 0	Day 4
Teak leaf (*Tectona grandis)*	9.68^{a}	6.88^{a}

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Banana leaf (*Musa paradiosiaca*)	8.16[b]	5.36[c]
Megaphynium macrostachyum leaf	7.60[c]	5.26[c]
Thaumatococcus daniellii leaf	7.97[b]	5.72[b]
HSD	0.27	0.25

Means with same superscript down the column are not significantly different based on Tukey's HSD test at $p \leq 0.05$

Table 3: Effect of selected wrapping leaves on the ash content of pap

Wrapping leaves	% Ash	
	Day 0	Day 4
Tectona grandis	2.47[ab]	1.95[a]
Musa paradiosiaca	1.99[d]	1.47[bc]
Megaphynium macrostachyym leaf	2.04[cd]	1.30[c]
Thaumatococcus daniellii leaf	2.28[bc]	1.70[ab]
HSD	0.25	0.32

Means with same superscript down the column are not significantly different based on Tukey's HSD test at $p \leq 0.05$

Table 4: Effect of selected wrapping leaves on the crude fat content of pap

Wrapping leaves	% Crude Fat	
	Day 0	Day 4
Tectona grandis leaf	0.83[a]	0.28[ab]
Musa paradiosiaca leaf	0.57[ab]	0.27[ab]
Megaphynium macrostachyym leaf	0.70[ab]	0.24[ab]
Thaumatococcus daniellii leaf	0.53[b]	0.16[b]
HSD	0.29	0.18

Means with same superscript down the column are not significantly different based on Tukey's HSD test at $p \leq 0.05$

Table 5: Effect of selected wrapping leaves on the crude fibre content of pap

Wrapping leaves	% Crude fibre	
	Day 0	Day 4
Thaumatococcus danielii leaf	1.20[c]	0.79[a]

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Musa paradiosiaca leaf	1.32^{bc}	0.44^{bc}
Megaphynium macrostachyym leaf	1.57^{a}	0.57^{b}
Tectona grandis leaf	1.36^{bc}	0.44^{bc}
HSD	0.18	0.18

Means with same superscript down the column are not significantly different based on Tukey's HSD test at $p \leq 0.05$

DISCUSSION

The results of the proximate composition before and after storage period showed that solid pap contains crude fat, crude fibre, crude protein, dry matter and ash .This report is similar to that of Enyisi *et al.*, (2014) for maize grains and maize products. Pikuila and Ilelaboye, (2020) and Oyarekua and Eleyinmi, (2019) also made similar reports on the proximate and chemical composition of 'eko elewe' prepared from maize grain. However, the modification of traditional process of maize to 'eko elewe' and then to pap have been reported to significantly affect their proximate composition (Oyarekua & Eleyinmi, 2019). The results on the moisture content revealed that moisture content which was at minimal percent at day 0 is an indication of stable shelf life if properly packaged and stored, because low moisture is necessary in food for ensuring premium quality and longer shelf life (Amadi & Adebola, 2018).

The ash content was found to be generally low probably due to leaching of soluble inorganic salts during steeping, fermentation and disposal of steep water prior to milling which is in agreement with the reported of Oyarekua and Eleyinmi (2019). The ash reduced from day 0 from 2.47% to 1.95% in pap wrapped with *T. grandis* leaf and with *M. macrostachyum* leaf from 2.04% to 1.30%, it is different from the findings of Faleye *et al*., (2020) who reported increase in ash content of stored food and attributed it to probably the condiments added, but agrees with the work of Fagbohun (2020) who reported depletion in ash content of non-infected cocoa seed during storage. Aziz *et al*., (2019) also reported that *Aspergillus flavus* depleted zinc and iron from infected crushed corn. Also, Pikuda and Ilelaboye, (2020) reported reduction in ash content of 'ogi' probably due to the large surface area of the substrate which hasten leaching of minerals into steep water during processing.

The crude fat composition was also found to decrease with period of storage. Probably, the decrease might be because of fungi infestation that produced enzyme lipase which hydrolyzed the fat for their use (Braid *et al.*, 2022). This is in agreement with the research of Onifade and Jeff-Agboola (2023) who reported the decrease in fat content of stored infected *Cocos nucifera*.

There was no significant change in crude fibre of pap wrapped with *T. daniellii* leaf, *Tectona grandis* leaf and *Musa paradiosiac* leaf between day 0 up to day 4 of storage but significantly different from pap wrapped with *M. macrostachyum* leaf. The slight reduction may be due to enzymatic degradation of the fibrous material during storage as reported by Oyarekua and Eleyinmi (2019). The initial value of the fiber content obtained from freshly prepared pap at day 0 agreed with report of Ujabadenyi and Adebolu (2015).

Crude protein content at day 0 (9.68%) to (6.88%) at day 4 was comparable with 4.12, 5.93%, 4.8% and 5.4% values reported by Oyarekua and Eleyinmi (2019). The decrease with the days of storage may probably be as a result of the microbial attack which might secret enzymes to hydrolyse the protein for their use as reported by Braide *et al.*, (2022). The finding was not in agreement with Pikuda *et al*., (2020) who reported an increase in protein content of samples on which fungi grow and that the increase could be from slight protein synthesis by proliferation of micro-organisms and synthesised enzyme protein. However, the protein content of nylon wrapped pap was higher than that of leaf at the end of storage.

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The processing operations involving steaming, fermentation and pressure cooking may increase the digestibility of starch, rendering it more susceptible to enzymatic digestion and hence the reduction (Oyarekua & Eleyinmi, 2019).

It is well known that fungi may cause a lot of deterioration and thus constitute hazards to the life of animals and man. The fungi isolated from stored pap in this study include the mesophilic fungi; *Aspergillus flavus, Aspergillus niger, Penicillium notatum* and *Neurospora species; Fusarium Mucor species.* They have been implicated in the deterioration of food substances by the earlier reports of Amadi and Adebola (2018), Fadahunsi *et al*., (2021), Braide *et al*., (2022), Faleye *et al*., (2020). These four fungi were isolated right from day 0, meaning that the pap has been contaminated by the spores of these fungi probably during processing from air or utensils used (Abbey, 2017).

The occurrence of the fungi was observed to increase with days of storage probably because of the increase in moisture content and digested food substances which support the growth.

CONCLUSION/RECOMMENDATION

The results showed that pap wrapped with *Thaumatococcus daniellii* leaf was safe for consumption than other leaves even after 4 days of storage with little deterioration. The use of other leaves to wrap pap should not be encouraged because it encourages fungi growth that in turn may produce aflatoxin which are secondary metabolites that are highly mutagenic and toxic for human and also animal as earlier reported in bean pudding, pounded yam and pap wrapped with *Musa paradiosiaca* leaves by Adegunloye *et al.*, (2022). Therefore, the study recommends *Thaumatococcus daniellii* to wrap solid pap "eko elewe". The leaves used in wrapping these food items produced some fungi into the food, It is therefore recommended that users of these leaves should wash their hands with clean water before using and food wrapped with these wrappers should be consumed as soon as possible to reduce multiplication of these fungi.

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