

Full Length Research Paper

Production and evaluation of instant emulsion base (“ncha”) from oil palm biogenic waste

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Instant emulsion base (“ncha”) was produced from oil palm biogenic waste by extraction, concentration and encapsulation. Traditional products which were prepared and commercial product served as controls. The formulated instant product and the controls were analyzed for compositions, selected physico-chemical, microbial and organoleptic properties. Instant formulated product (IP) showed significantly ($p < 0.05$) higher level of iron (Fe): 8.29 ± 0.014 mg/g than the controls (traditional palm waste product- TP: 0.52 ± 0.014 mg/g, traditional palm waste blend product- TPWB: 5.70 ± 0.283 mg/g, commercial palm waste product- CP: 0.52 ± 0.42 mg/g). The controls also showed comparable levels of K, Ca, Mg and Zn with the formulated instant product. Untrained panelists made up of 30 persons scored the emulsions when used for the preparation of African tapioca salad (“Abacha ncha”) on a 9-point Hedonic scale for appearance, colour, smoothness and taste. Results indicated that the instant product was significantly accepted ($p < 0.05$) with the controls which are already in use. Besides, all the emulsion based products had pH range of 9.0 to 11.6 and exhibited zero mould and reduced total microbial load counts indicating microbial stability even under storage period of 3 weeks at ambient conditions. The overall results indicated that instant formulated product even though an innovation to the controls was highly preferred and could be a convenient means of preparing African tapioca salads by both rural and urban dwellers.

Key words: Convenient foods, oil palm wastes, salad dressing, tapioca salads.

INTRODUCTION

Food waste management, recovery and utilization is the series of activities where discarded food materials are collected, sorted, processed and converted into non-edible/edible new products (Anonymous, 2013a). Besides, large amounts of waste products evolve during production, preparation and consumption of foods. Hence, to maintain a healthy environment, reduction in waste is universally acceptable but in practice the dream has not been

accomplished. Oil palm as an economic crop is so useful that none of its by-products is considered a waste. The bunch of the oil palm fruits which may be considered a waste after the fruit removal, is used by some communities in Eastern parts of Nigeria to produce an edible emulsion base (a mild soap) called “Ncha”. It is an African salad dressing–water in oil emulsion. This emulsion is used in the preparation and consumption of African salad (“Abacha

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ncha”), bitter yam and processed oil bean seed (“Ugba”). Many food products such as milk, salad dressings, gravies and other sauces, whipped dessert to pings, peanut butter and ice cream are emulsions of edible fats and oils. They affect the physical form of the food product in addition to impacting taste because emulsified oils coat the tongue, impacting “mouth feel” (Anonymous, 2010). In this study, “Ncha”, which is a native food item, has an added value by making it instantly through extraction, concentration and encapsulation. The traditional products, palm waste (TP) and palm waste blend (TPWB) were prepared through modifications of local method. Commercial palm waste emulsion base product (CP) that was also prepared, acted as the control.

METHODOLOGY

The oil palm bunch wastes used for this experimental study were procured from a farm in Nsukka town of Enugu State, Nigeria. Fresh tender kola nut leaves were also collected from the above farm while commercial palm product was purchased from a market in the same town. Weighing balance (50 kg capacity, “Five goats” with model no. Z051099) was used.

Production of emulsion products from the ashes of wastes

The oil palm wastes were open sun dried and divided into two portions (Figure 1). The first portion which was 5.1 kg was burnt together with 1 kg of kola nut leaves (KL), after which it was allowed, to cool. The residue obtained was subjected to ashing in a furnace at a temperature of about 650°C for 4 h (Pearson, 1976). This led to the production of creamy white ash product without traces of carbon. The 200 g of ash obtained was mixed with 100 ml of palm fruit sludge (PFS), 20 ml of palm oil (PO) and 60 ml of kola-nut leaves extract. The sample was molded into round shaped balls and allowed to dry at ambient-temperature (27°C) for three days. The second portion of the dried palm waste was burnt and allowed to cool. The ash (250 g) was re-hydrated with 2.5 L of clean tap water and allowed to extract for 3 weeks. During the extraction period, the total soluble solid (TSS) of the supernatant was monitored. On the last day of the monitoring, supernatant was decanted, filtered and divided into two portions. The first portion was bottled (TP) while the second portion was concentrated in a water bath at 100°C. The concentrated extract was encapsulated with edible starch, cold extruded, dried and packaged as instant “Ncha”.

Kola nut leaf extract

Healthy and tender fresh leaves (0.5 kg) were collected from a kola nut tree as mentioned above and washed thoroughly with clean salty cold water. The leaves were drained; coarsely cut using kitchen knife with one liter (1.0 L) of clean tap water added and the mixture blended with domestic blender (Ken wood model). The blended mixture was separated using cheese cloth.

Analyses of raw materials and finished products

Proximate analysis

Ash, moisture and fiber contents of the raw palm bunch waste were determined using AOAC (2010) method. Crude fat, nitrogen and

protein contents of the raw material were also determined using soxhlet extraction and micro-Kjeldahl methods as described by AOAC (2010), respectively. Total carbohydrate for the raw material was calculated by difference (AOAC, 2010).

Vitamin C analysis

This was done on the fresh kola-nut leaves and palm waste. 5 g of each extract from the raw materials were placed in a 100 ml volumetric flask and 2.5 ml of 20% Meta phosphoric acid was added as a stabilizer. The entire mixture was diluted to 100 ml with distilled water. 10 ml of the solution was then pipetted into a flask and 2.5 ml of acetone added. Absorbance reading was taken at 414 nm using UV spectrophotometer (Bausch and Lomb Spectronic 21 (PEC Medicals, USA).

Mineral composition analysis

This was done using dry ashing method as described by Pearson (1976).

pH analysis

This was carried out using 20 ml of sample each obtained from the final products. A pH meter was used (pocket-sized pH meter-RI02895, Hanna Instruments Italy).

Total titratable acidity

This was done by mixing 10 ml of distilled water, few drops of Bromothymol blue indicator with 5 ml of emulsion sample. This was then titrated against 0.1 N sodium hydroxide (NaOH) to a blue coloured end point.

Total soluble solids

Five milliliters (5 ml) volume of sample was measured into an already dried, weighed crucible. The crucible was placed in an oven and allowed to dry at 30°C for 2 h. The crucible with the sample was weighed.

$$\text{Total soluble solids} = \frac{\text{Weight (sample + crucible)} - \text{weight of crucible}}{\text{Weight of sample used}}$$

Turbidity

This was carried out using photo-electric colorimeter (Portable photoelectric colorimeter, AP-1000M-Japan) with absorbance reading taken at 530 nm wave length.

Colour

Photo-electric colorimeter was used with transmittance reading at 490 nm (Portable photoelectric colorimeter, AP-1000M-Japan).

Microbial analysis

Total viable and mould counts (CFU/ml) of the “Ncha” products (FCP: filtrate from commercial product; FTPWB: Filtrate from palm

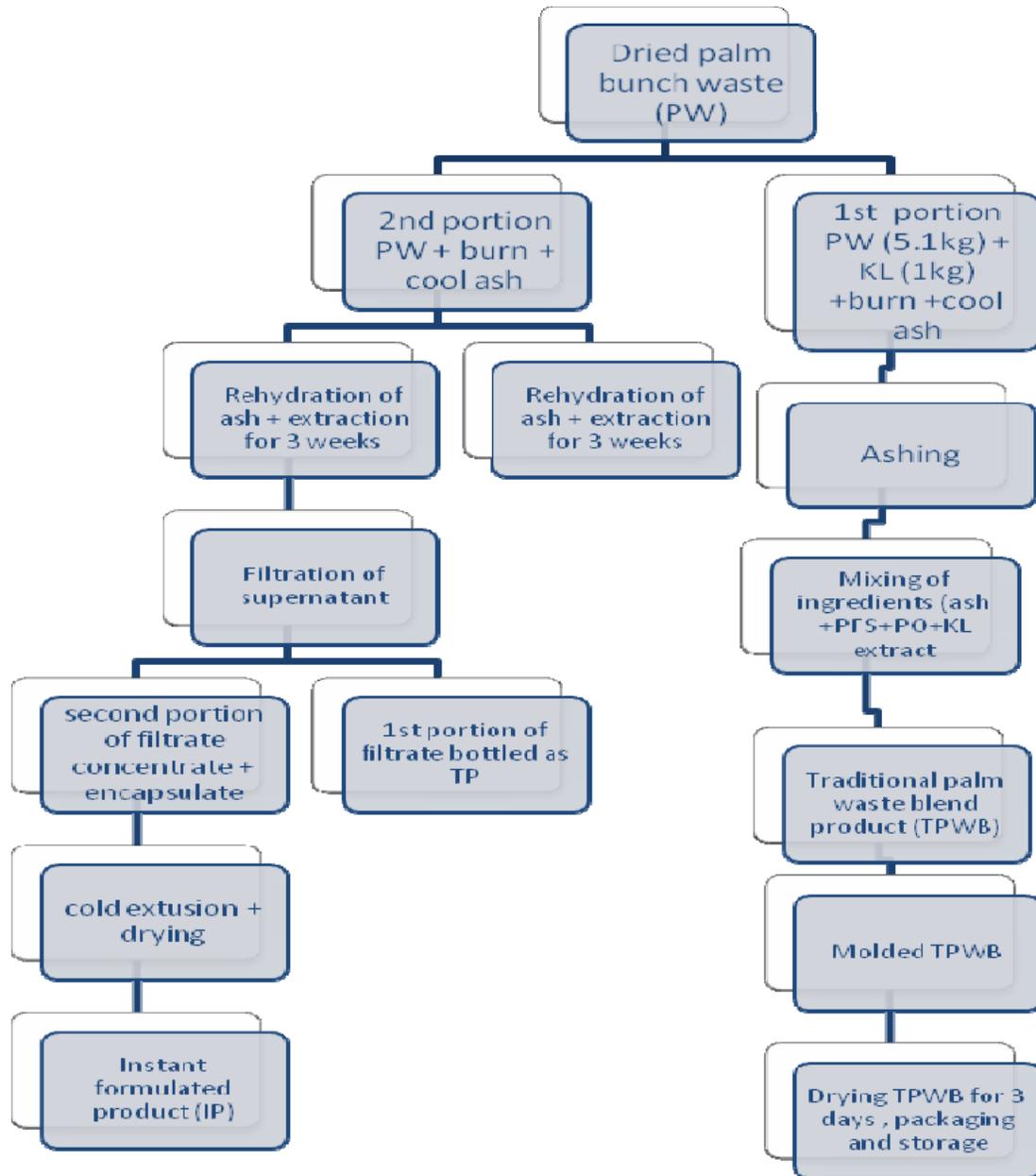


Figure 1. Flow chart for production of emulsion products. PW- palm bunch waste; TP- traditional palm bunch waste product; PFS- palm fruit sludge; PO- red palm oil; KL- kola nut leaves; TPWB- traditional palm bunch waste blend product; IP- instant formulated product.

waste blend product, FIP: filtrate from instant product), were determined using the methods described by Okore (2004).

Sensory evaluation

The emulsion base products (TP: Traditional palm bunch waste product, CP: Commercial product, TPWB: Traditional palm waste blend product, IP: Instant formulated product) were used to prepare “Abacha ncha”, the African tapioca salad. The solid base of the final products from CP, TPWB and IP was reconstituted in warm water and filtered. The TP was also re-filtered. Filtrate of each was differently mixed with palm oil in a plastic bowl to form emulsion.

Other ingredients such as pepper, salt, crayfish, maggi cubes and “ugba” were added before mixing with the “Abacha”.

The prepared “Abacha ncha” samples (TP 1; CP 2; TPWB 3; IP 4) were served to 30 untrained panelists that scored the appearance, colour, taste and smoothness attributes of the tapioca salads on a 9-point Hedonic scale where nine (9) was extremely like and one (1) was extremely dislike (Iwe, 2002). The sensory scores were analyzed statistically using SPSS software package 17.0 version.

Data analysis

The data collected for the experiment were subjected to one way

Table 1. Proximate composition of both raw materials and finished products.

Parameter	PW	KL	FTP	FTPWB	FCP	FIP	CP
Moisture (%)	5.50 ^a ±0.141	7.85 ^b ±0.071	84.70 ^c ±0.283	66.60 ^d ±0.424	93.40 ^e ±0.566	72.60 ^f ±0.424	63.30 ^g ±0.424
Ash (%)	6.0 ^a ±0.707	6.35 ^{ab} ±0.071	2.40 ^c ±0.238	22.40 ^d ±0.566	5.20 ^{ae} ±0.283	17.65 ^f ±0.071	23.90 ^g ±0.141
Protein (%)	4.73 ^a ±0.042	17.36 ^b ±0.041	1.40 ^c ±0.014	0.70 ^d ±0.141	1.40 ^c ±0.141	0.70 ^d ±0.283	2.10 ^e ±0.071
Fibre (%)	62.55 ^a ±0.707	35.70 ^b ±0.014	Trace	Trace	Trace	Trace	Trace
Fat (%)	0.40 ^a ±0.283	0.09 ^b ±0.014	Trace	0.20 ^{ab} ±0.071	Trace	7.75 ^c ±0.071	0.20 ^{ab} ±0.141
Carbohydrate (%)	0.82 ^a ±0.028	32.70 ^b ±0.283	11.50 ^c ±0.141	10.10 ^d ±0.028	0.0 ^e	0.0 ^e	10.5 ^f ±0.141

Values are means ± SD for triplicate determinations; n=2. Values with same superscript among rows indicate no significant ($p>0.05$) difference. CP: Commercial product, PW: palm bunch waste, KL: kola-nut leaves, (TPWB): palm bunch waste blend product, FTP: filtrate from palm bunch waste product; FTPWB: filtrate from palm waste blend, FCP: filtrate from commercial product, FIP: filtrate from instant product.

Table 2. Mineral composition of the ash from palm bunch waste, kola-nut leaves, palm waste blend and the different "ncha" products.

Parameter (mg/g)	PW	KL	TPWB	CP	FTP	FPWB	FCP	FIP
K	0.21 ^a ±0.014	0.22 ^{ab} ±0.028	0.20 ^a ±0.028	0.28 ^b ±0.042	0.17 ^{ac} ±0.042	0.11 ^c ±0.028	0.10 ^d ±0.140	0.16 ^{a^{cd}} ±0.028
Na	0.013 ^a ±0.004	0.005 ^{ab} ±0.003	0.10 ^c ±0.014	0.00 ^b				
Fe	175.46 ^a ±0.000	64.01 ^b ±0.0141	174.81 ^c ±0.000	6.74 ^d ±0.057	0.52 ^e ±0.028	5.70 ^f ±0.283	0.52 ^f ±0.014	8.29 ^g ±0.014
Zn	10.75 ^a ±0.071	22.39 ^b ±0.028	15.40 ^c ±0.000	12.89 ^d ±0.000	0.72 ^e ±0.028	8.96 ^f ±0.042	6.09 ^g ±0.622	3.94 ^h ±0.042
P	0.70 ^a ±0.000	1.21 ^b ±0.014	0.91 ^c ±0.028	0.00 ^d				
Mg	25.05 ^a ±0.071	51.84 ^b ±0.014	24.91 ^c ±0.014	41.68 ^d ±0.042	0.028 ^e ±0.141	43.61 ^f ±0.042	11.87 ^g ±0.023	0.83 ^h ±0.042
Ca	10.80 ^a ±0.141	29.52 ^b ±0.028	3.60 ^c ±0.028	14.88 ^d ±0.028	0.96 ^e ±0.000	12.48 ^f ±0.000	4.32 ^g ±0.014	0.96 ^e ±0.028

Values are means ± SD for triplicate determinations; n=2. Values with same superscript among rows indicate no significant ($p>0.05$) difference. CP: Commercial product, PW: palm bunch waste, KL: kola-nut leaves, TPWB: palm bunch waste blend product, FTP: filtrate from palm bunch waste product; FTPWB: filtrate from palm waste blend, FCP: filtrate from commercial product, FIP: filtrate from instant product.

analysis of variance (ANOVA) in completely randomized design (CRD). The treatment means were separated with Fisher's least significant difference test (FLSD) at 95% confidence limit.

RESULTS AND DISCUSSION

Table 1 displays the result of proximate composition of the raw materials (palm bunch waste- PW and kola nut leaves- KL) and the filtrates (F) obtained from the ashes such as FTP (palm

bunch waste product filtrate), FTPWB (palm bunch waste blend filtrate), FCP (commercial product filtrate) and FIP (instant product filtrate). Extract obtained from CP had highest ash content (23.90%) followed by that from TPWB (palm bunch waste blend) and then IP- instant product (Table 1). Consequently, these products may contain a lot of macro and micro minerals (Onwuka, 2005). The protein content of the extract from each "ncha" base product (FTP, FTPWB, FCP and FIP) indicated the presence of

nitrogen. This implies that the formulated instant product could make contributions to the nutritional composition as much as the traditional "ncha" products (FTP, FTPWB). Table 2 presents the mineral composition of the ashes obtained from palm bunch waste, kola nut leaves and a blending of the two. Traditionally, kola nut or okra leaves which contain appreciable level of mucilage (Anonymous, 2013b) are used to add binding properties to "ncha" products. Besides, analysis of vitamin C composition of kola nut leaves extract

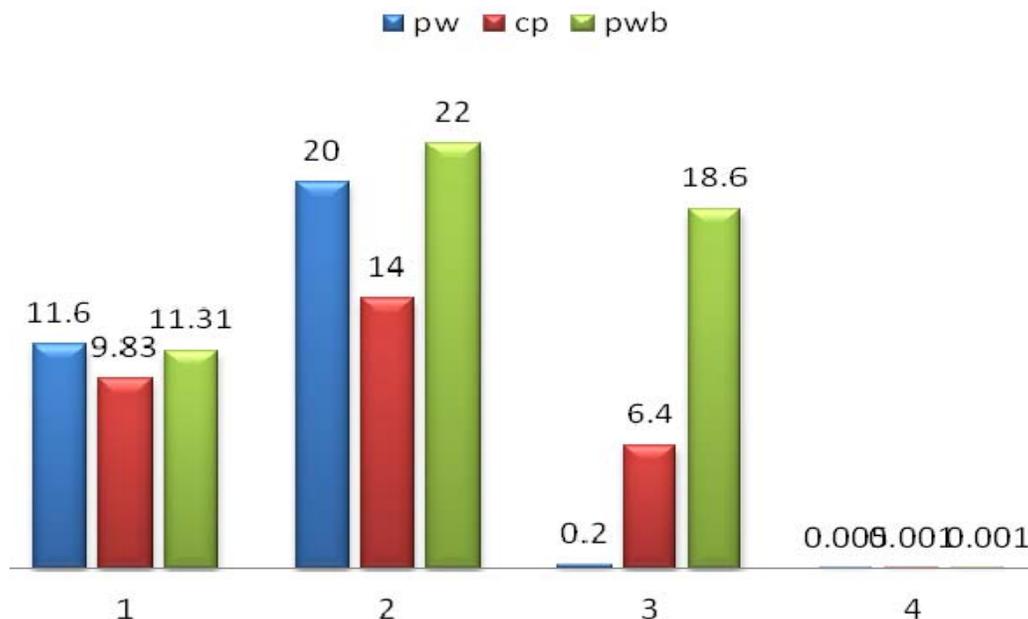
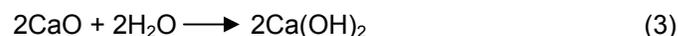
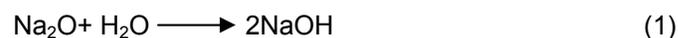


Figure 2. Physico-chemical properties of soaked ashes of "ncha" products. 1- pH values; 2- total soluble solids (mg/l); 3- turbidity (TU); 4- colour; pw (TP): Palm bunch waste product, CP: Commercial product; pwb (TPWB): Palm waste blend product.

showed that it contained 15.07 mg per 100 g of the sample. Hence, addition of this extract could be a good source of vitamin C as an antioxidant, to the salad prepared from FTPWB emulsion base. The PW ash was highest in iron (Fe) content, 175.46 mg/g, which is one of the prevalently deficient micronutrients required for the maintenance of health for both adult and children (Wilson, 2010). This is one of the reasons why the extract from the palm bunch waste ash was formulated into instant product. Also, extract from commercial product had very low iron content (0.52 mg/g) as compared to that of formulated instant product (8.29 mg/g). However, the commercial product extract contained significantly ($p < 0.05$) higher amount of Mg, Zn and Ca. Generally, the mineral composition of the extract from palm bunch waste ash as TP of Table 2 was low but formulation of part of the extract into instant base product gave rise to improved micronutrient composition. The mineral composition of the extract from TPWB was significantly ($p < 0.05$) higher especially for Mg, Ca and Fe micronutrients as compared to the other extracts (FTP, FCP and FIP). Nevertheless, all the extracts including the commercial product, CP, indicated zero phosphorus contents during analysis. However, it is evident from these results that the use of traditional emulsion base products in salad preparations is still highly encouraged as they may contribute these nutrients when utilized in salad preparations. Also, results of selected physical and chemical properties of the ashes from TP, CP and TPWB are shown in Figure 2. The pH of all the extracts was on the high alkaline side and such alkalinity produce very

good emulsion base required for the salad preparations. Total soluble solids were very high in TPWB ash extract followed by the TP ash at day 21 (last day of extraction) and suggest that the extraction of soluble constituents from the ash increase with soaking time. This agreed with the report of Irvine (1985) that agricultural waste materials such as palm bunch waste, cocoa pod, plantain peels, banana leaves, maize cob, wood sugar beet waste among others, contain a good percentage of potash. Consequently, when these materials are burnt in air, the resulting ashes contain oxides of potassium and sodium including calcium which can dissolve in water to yield corresponding hydroxides as shown in Equations 1, 2 and 3:



Such soluble hydroxides in the emulsion base act as surfactants and combine with palm oil during the preparation of African tapioca salad to form mild soap. Unexpectedly, the turbidity and colour remained unchanged when the total soluble solids changed with soaking/extraction time (3 weeks). This may indicate that these extracts would be stable in terms of these properties under long storage. The results of the turbidity also showed that the extract from TP was clearer than that of CP and TPWB (Figure 2). Again, total microbial

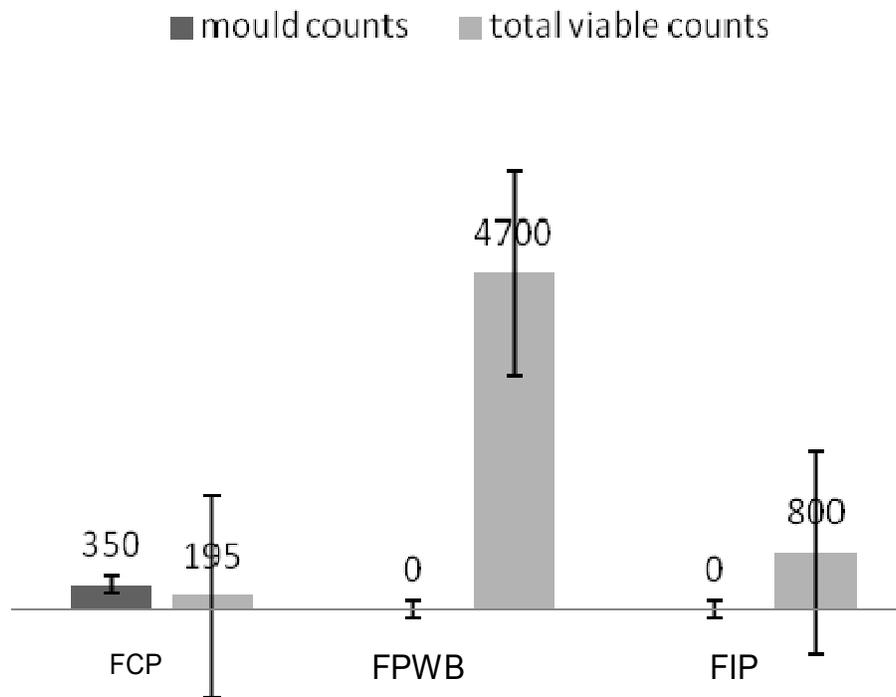


Figure 3. Total viable and mould counts (CFU/ml) of the “ncha” products. FCP: filtrate from commercial product; FPWB (FTPWB): Filtrate from palm waste blend product, FIP: filtrate from instant product; T: error bars with standard error of one (1); sample size, n = 3.

Table 3. Sensory scores of African tapioca salad prepared with the “ncha” samples.

Parameter	TP (1)	CP (2)	TPWB (3)	IP (4)
Appearance	7.40 ^a ±1.56	8.16 ^a ±1.17	6.17 ^a ±4.53	7.20 ^a ±0.18
Colour	7.10 ^a ±1.64	8.17 ^a ±1.23	7.83 ^a ±1.29	7.60 ^a ±1.64
Taste	7.67 ^a ±1.44	7.70 ^a ±1.73	7.70 ^a ±0.71	7.40 ^a ±2.69
Smoothness	7.37 ^a ±1.63	7.50 ^a ±1.41	8.10 ^a ±1.26	7.17 ^a ±1.78
Overall acceptability	7.30 ^a ±1.15	7.50 ^a ±1.0	8.10 ^a ±1.0	7.17 ^a ±1.26

Values are means ± SD for triplicate determinations; n=2. Values with same superscript among rows indicate no significant ($p>0.05$) difference. TP: Palm bunch waste product, CP: commercial product, TPWB: PALM waste blend product, IP: instant product.

load (total viable) and mould counts (Figure 3) for all the products during the extraction period showed zero mould count and reduction in total viable counts as the extraction time increased. However, zero mould count and reduced total viable counts of the instant formulated product as compared to that of commercial and palm waste blends, highlight the reduction of health hazards in using this new product as a salad dressing in African tapioca salad preparations. Error bars with standard error of 1 (Figure 3) further showed that the total viable counts obtained for TPWB filtrates was significantly ($p<0.05$) higher than that of FIP with FCP having the lowest value. However, there was no significant difference ($p>0.05$) for the mould counts of FTPWB and FIP while FCP has highest value of this count (Anonymous, 2014). The results of the sensory evaluation of African tapioca salad

prepared from the different emulsion base are shown in Table 3. There were no significant differences ($p>0.05$) in appearance, colour, taste and smoothness of the salads prepared from extracts of TP, CP and IP. Overall, acceptability indicated that African salad prepared from the instant product was highly acceptable together with those of traditional products.

Conclusion

This investigation has shown that biological wastes such as palm bunch waste could be processed into edible instant formulated emulsion base product which is very simple, fast and convenient for preparing African tapioca salads. Hence, the local potash popularly known as “ngu”

in the Eastern part of Nigeria can be transformed into convenient form for the benefit of city dwellers and career women. Besides, data base were provided for the traditional emulsion base products.

Conflict of Interests

Authors have declared no conflict of interest

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