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Research Paper

Effect of packaging materials on the storage conditions of salad cream from cassava, sweet potato and three leaf yam starches

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Abstract. Salad cream was prepared from starches of cassava, three leaf yam and sweet potato. The proximate parameters of the cream were evaluated and the salad cream were packaged in plastic and bottle containers and stored for a period of six week. Proximate analysis of salad cream showed cassava starch salad cream to have the highest moisture (58.96%), while protein was (0.46%), carbohydrate was (37.18%) with control as highest respectively. Three leaf yam starch salad cream had the highest ash content 2.30% and lowest fat content (21.08%). Fat content showed no significant difference ($p > 0.05$), while total available carbohydrate (TAC) was significantly different ($p < 0.05$) from all other samples. Storage parameters such as moisture, peroxide value (PV), total titratable acidity (TTA), free fatty acid (FFA) and pH increased with storage. Moisture content of the stored cream in bottle and plastic containers was highest at six weeks (60.85%) in both cases, while peroxide value ranged from (0.67 to 5.55 mEq/kg) with control as lowest and three leaf yam salad cream as the highest. Total titratable acidity (TTA) ranged from 0.11 to 0.40% and from 0.09 to 0.39% for bottle and plastic stored salad cream, respectively. Free fatty acid (FFA) for the bottle stored cream ranged from 0.13 to 1.52%, while plastic stored salad cream ranged from 0.16 to 2.72% with cassava salad cream having the lowest and control the highest respectively. pH ranged from 3.75 to 4.95 in bottle and 3.78 to 4.81 in plastic stored salad cream over a period of six weeks with three leaf yam starch salad cream as highest respectively. There was a significant difference ($p < 0.05$) in all the storage parameters over a period of six weeks.

Keywords: Package, storage, proximate, sensory, salad cream, starches.

INTRODUCTION

The consumption of salad cream in Nigeria in general and Port Harcourt city in particular has increased tremendously in the recent past as a result of the widespread use with vegetables during official and domestic functions. Conventionally, salad cream is packaged in bottle. Salad cream a creamy, yellow condiment based on an emulsion of about 25 to 50% of oil in water is emulsified by egg yolk and coloring. It contains 30 to 40% vegetable oil which account for 35% of the production of all dressings, mayonnaise and sandwich spreads (Cleese and Booth, 2001). Mixture of vegetable is prepared with various ingredients of which modified flour serves as the base raw material (Turgeon et al., 1996).

For people not too familiar with salad cream, the condiment is probably similar to mayonnaise in term of composition and texture. Mayonnaise was made also in same process of salad cream although salad cream is

slightly yellowish, rather than white and the flavor of salad cream is a bit complex.

The major ingredients of salad cream include: egg yolk, mustard, vinegar, vegetable oil and sugar. Many salad creams are also lightly seasoned, coming in a variety of flavor to cater for various palates depending on the brand and style (Turgeon et al., 1996)

Despite the fact that corn starch has been used in the preparation of salad cream sold in the Nigerian market, not much attention has been given to its development from other types of starch like sweet potato, cassava and three leaf yam starches. These can also be used as an alternative in the preparation of salad cream.

As an additive for food processing, food starches are typically used as thickeners and stabilizers in foods such as puddings, custards, soups, sauces, gravies, pie fillings, and salad dressings, and to make noodles and pastas. It serves as an energy giving foods but also can readily be converted chemically, physically and applied in diverse industries such as foods, papers, textiles, adhesives, beverage, confectionery, building materials and pharmaceuticals (Starch Wikipedia). Conventionally, salad cream and similar product are stored in bottle containers which are subject to rust as a result if interaction between the bottle and the lid and also to breakage. The objectives of the study are:

1. To prepare and evaluate the proximate properties of cassava, sweet potato and three leaf yam based salad cream.
2. To determine the effect of different packaging material on the storage properties of salad cream over a period of six weeks.

MATERIALS AND METHODS

Cassava root were obtained from Agriculture development program (ADP) 24 h after harvest. Sweet Potato tubers were obtained from mile 3 market in Port-Harcourt and three leaf yam was obtained from Elimgbu Town in Obio Akpor Local Government Area all in Rivers State, Nigeria and processed within 24 h after harvest.

Chemicals

Chemicals used for the analysis were obtained from the Department of Food Science and Technology, Rivers State University of Science and Technology. All chemical used for this study were of analytical grade.

Processing of starch

The method described by Osunsami et al. (1998) was used for the production of various starches (Figure 1). The cassava, sweet potato and three leaf yam tubers were harvested and washed to remove soils and dirt from the skin, then peeled using kitchen knife. The peeled tubers were washed, blanched using 0.05% sodium metabisulphite (sweet potato and three leaf yam), grated with an electric motor blender and sieved by washing off in a basin of water. The mixture were filtered through a fine mesh sieve (Muslin cloth). The filtrate was allowed to settle and the supernatant(effluent) decanted and sediment obtained (cassava and potato). Three-leaf yam was allowed to go through sedimentation and thereafter the sediment was centrifuged at 4000 rpm for 20 min and the wet starch obtained. The cassava, potato and three-leaf yam wet starches were oven dried for 24 h at 50°C. The starch obtained was a white odorless and tasteless starch.

Recipe for salad cream production

The following items and quantities were used for the production of salad cream. Starch 154 g, mustard paste 20 g, salt 90 g, sugar 36 g and vinegar 375 ml, 2 egg Yolk, vegetable oil 625 ml.

Preparation of salad cream

Dry cassava, potato and three-leaf yam starches were reconstituted in water and vinegar, salt, sugar and mustard added and cooked over heat (120°C for 10 min) until gelatinization occurred (translucent color). The gelled starches were then cooled at room temperature and blended in a warring blender for one minute after which egg yolk and vegetable oil were added and blended for another five minutes. The resultant salad cream were then dispensed into sterile plastic and bottle containers respectively and stored at room temperature for further analysis.

Proximate analysis of salad cream

The moisture content, ash, crude fat and fiber contents of the salad cream samples were determined using the air oven method and total available carbohydrate (TAC) determined by the method described by the AOAC (1990). Crude protein was determined by difference.

Storage properties

The amount of free fatty acid (FFA) and total titratable acidity (TTA) were determined by the AOAC method

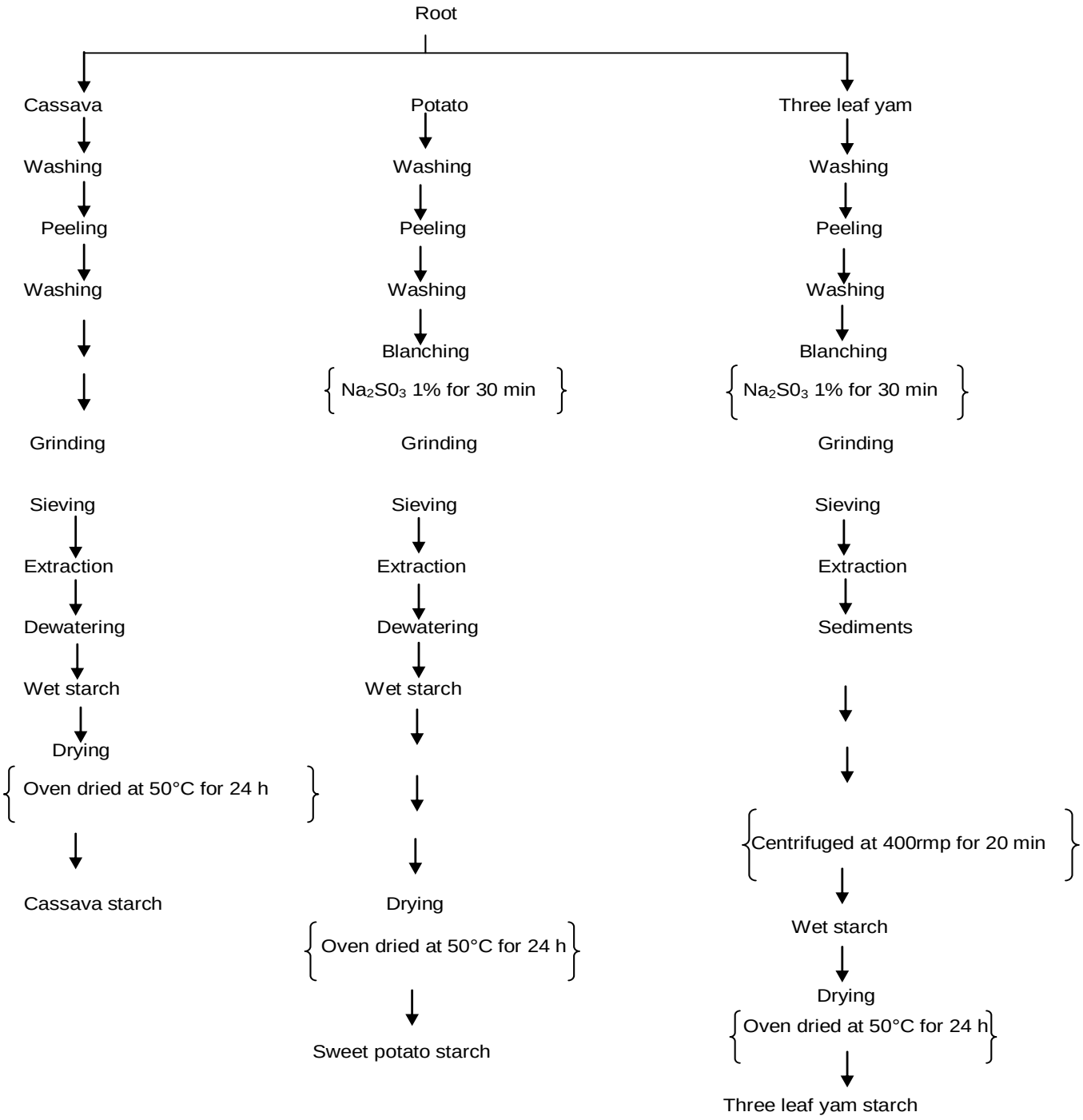

Figure 1. Flow chart for the production of cassava, sweet potato and three leaved yam. Source: Osunsami et al. (1998) (modified).

(1990). Peroxide value (PV) was determined by the Pearson's method (1990). pH of samples were determined using a digital pH meter (model PHS – 2F, Harris England) after it was calibrated using standard buffer of pH 4.0 and 7.0.

Statistical analysis

All data obtained from various analysis were subjected to analysis of variance (ANOVA) using the statistical package for social sciences (SPSS) version 20.0. Means

Table 1. Proximate composition of cassava, sweet potato and three leaf yam starch based salad cream (%).

Sample	Moisture content	Protein content	Fat content	Ash content	Carbohydrate
Cassava	58.96 ± 0.02[a]	0.17 ± 0.57[b]	19.00 ±12.64[a]	1.67 ± 0.13[b]	16.04 ± 0.06[c]
Sweet potato	52.79 ± 0.78[b]	0.31 ± 0.23[a]	20.58 ±1.41[a]	1.80 ± 0.28[b]	13.99 ± 0.72[c]
Three leaf yam	50.65 ± 1.56[b]	0.19 ± 0.21[b]	17.39 ± 3.97[a]	2.30 ± 0.11[a]	29.39 ± 3.97[b]
Control	39.98 ± 1.65[c]	0.46 ± 0.06[a]	21.08 ± 3.71[a]	1.79 ± 0.63[b]	37.18 ± 0.69[a]

Means on the same column bearing same superscripts are not significantly different (P>0.05)

were separated using new Duncan's multiple range tests (Duncan, 1955) at 95% confidence level ($p < 0.05$).

RESULTS AND DISCUSSION

Proximate composition of cassava, sweet potato and three leaf yam based salad cream

Table 1 shows the proximate analysis result of cassava, sweet potato and three leaf yam starch based salad cream. Moisture content range from 39.98 to 58.96% with the control (commercial salad cream) having the least and cassava salad cream having the highest. The result of this analysis was higher than that reported by Babajide and Olatunde (2010), who reported moisture content of 48.80 to 49.79%. Eke-Ejiofor and Owuno (2014) also reported a moisture content of 57.84 to 64.88% for cassava and potato starch based salad cream.

The lower moisture content of the control (commercial salad cream), may be attributed to the difference in starch origin and also an indication that the tuber starches could absorb more water than cereal starches. Reduced moisture content implies better shelf life, storability and stability of product.

Protein content of salad cream ranged from 0.17 to 0.46% with cassava salad cream having the least and control the highest. This findings are higher than the range 0.23 to 0.35% reported by Eke-Ejiofor and Owuno (2014) and that reported by Babajide and Olatunde (2010) which was 2.63 to 3.28%.

Fat content ranged from 17.39 to 21.08% with the three leaf yam salad cream having the least and control the highest. Eke-Ejiofor and Owuno (2014) reported a fat content of 25.17 to 28.15% in cassava and potato starch based salad cream, while Babajide and Olatunde (2010) reported a fat content of 27.04 to 29.68% in corn-cocoyam starch salad cream. The higher fat content of the control sample (commercial salad cream) may be a function of the type of vegetable oil used during preparation.

Ash content ranged from 1.67 to 2.30% with cassava salad scream having the least and three leaf yam salad cream the highest. Moisture, protein, fat and ash fell within the range reported by Ashaye et al. (2010) and Eke-Ejiofor and Owuno (2012).

Total available carbohydrate (TAC) ranged from 13.99 to 37.18% with sweet potato cream as the least and controls as the highest. The result of the present study is higher than that reported by Eke-Ejiofor and Owuno (2014). Sweet potato has a low glycemic index, indicating low digestibility of the starch despite its high carbohydrate content and so appropriate for use.

Storage properties for cassava, sweet potato and three leaf yam starch based salad cream

Tables 2 and 3 shows the storage properties of cassava, sweet potato and three leaf yam starch based salad cream stored for six weeks with two packaging material (plastic and bottle containers). Conventionally, salad cream and related products were stored in bottles of known tensile strength, but little or no information exist on the use of plastics in the storage of salald cream. High density polyethylene (HDPE) was used to store the cream, because of their large strength–to-density ratio (Thermoforming HDPE), which range from 0.93 to 0.97 g/cm^3 or 970 kg/m^3 (typical properties of PE) and higher specific strength (Compare materials: HDPE and LDPE withstanding somewhat higher temperatures (120°C/248°F for short periods, 110°C/230°F continuously). Salad cream stored in bottle and plastic containers over a period of six weeks showed an increase in value over the storage period in all the parameters studied.

Moisture content (MC) of cream stored in bottle ranged from 39.78 to 60.85% while plastic stored cream ranged from 39.89 to 60.85% with the control having the least value and the cassava based salad cream having the highest moisture. Substitution of corn starch with other tuber starches, which have the ability to absorb more water as shown in this study may be responsible for the increase in moisture content of the salad cream samples which also increased with storage.

Peroxide value (PV) ranged from 0.67 to 5.55 mEq/kg in bottle stored cream and 0.67 to 4.82 mEq/kg in plastic stored cream, with control as the lowest and the three leaf yam starch based salad cream as the highest respectively. Storage of salad cream in bottle container

Table 2. Storage properties of salad cream stored in bottle container over a period of six weeks.

Sample	Period of storage (weeks)	Moisture content (%)	Peroxide value (mEq/kg)	Total titratable acidity (%)	Free fatty acid (%)	pH
Cassava	0	55.58 ± 0.02^{ab}	1.75 ± 0.21^{fg}	0.14 ± 0.00^{gh}	0.13 ± 0.03^{g}	3.75 ± 0.07^{h}
	2	57.20 ± 0.02^{ab}	2.35 ± 0.35^{ef}	0.17 ± 0.6^{fg}	0.23 ± 0.61^{cde}	4.15 ± 0.07^{f}
	4	57.21 ± 0.00^{abc}	2.85 ± 0.21^{def}	0.20 ± 0.00^{df}	0.37 ± 0.01^{cde}	4.45 ± 0.07^{cd}
	6	60.85 ± 0.91^{a}	3.25 ± 0.49^{cde}	0.21 ± 0.01^{cdo}	0.41 ± 0.01^{cd}	4.75 ± 0.01^{b}
Sweet Potato	0	52.79 ± 0.19^{bc}	3.40 ± 0.71^{cde}	0.11 ± 0.00^{cde}	0.22 ± 0.04^{fg}	3.95 ± 0.07^{g}
	2	52.80 ± 0.32^{ab}	4.05 ± 1.06^{bcd}	0.13 ± 0.01^{h}	0.37 ± 0.01^{cde}	4.20 ± 0.00^{ef}
	4	54.10 ± 1.28^{bc}	4.35 ± 0.78^{abc}	0.13 ± 0.00^{h}	0.48 ± 0.00^{cd}	4.35 ± 0.07^{df}
	6	56.10 ± 3.90^{bc}	4.95 ± 0.07^{ab}	0.15^{g} ± 0.01^{h}	0.51 ± 0.01^{c}	4.55 ± 0.0 ^{c}
Three leaf yam	0	50.35 ± 1.14^{c}	2.79 ± 0.07^{def}	0.13 ± 0.03^{gh}	0.18 ± 0.01^{fg}	4.45 ± 0.07^{cd}
	2	51.71 ± 2.26^{bc}	3.89 ± 0.64^{bcd}	0.14 ± 0.00^{gh}	0.24 ± 0.01^{fg}	4.10 ± 0.00^{fg}
	4	53.87 ± 2.26^{bc}	4.45 ±0.64^{abc}	0.17 ± 0.04^{gh}	0.32 ± 0.03^{def}	4.55 ± 0.07^{c}
	6	55.76 ±1.05^{abc}	5.55 ± 0.49^{a}	0.18 ± 0.02^{fg}	0.34 ± 0.02^{def}	4.95 ± 0.07^{a}
Control	0	39.78 ±1.65^{d}	0.67 ± 0.68^{g}	0.25 ± 0.03^{c}	0.87 ± 0.00^{b}	4.15 ± 0.07^{cd}
	2	40.51 ± 0.86^{d}	2.81 ± 0.52^{def}	0.26 ± 0.00^{c}	0.87 ± 0.00^{b}	4.45 ± 0.07^{cd}
	4	41.07 ± 2.24^{d}	3.00 ± 0.00^{def}	0.30 ± 0.00^{b}	1.46 ± 0.02^{a}	4.75 ± 0.07^{c}
	6	42.73 ± 0.81^{d}	3.90 ± 0.14^{bcd}	0.40 ± 0.02^{a}	1.52 ± 0.02^{a}	4.38 ± 0.21^{b}

Means on the same column bearing same superscripts are not significantly different ($p > 0.05$)

showed a higher peroxide value though within the allowable limits. Peroxide value for all the samples were less than 10 mEq/kg, indicating that the salad cream samples were safe. Pearson (1990) stated that a rancid taste begins to be noticeable when oil has PV of 10 to 20 m/Eq/kg. Finberge (1995) also reported that PV was noticed to increase over the storage week for mayonnaise, indicating that dressing gets rancid gradually on storage. Weiss (1990) defined peroxide value as the amount oxygen per 1 kg of fat or oil and reflects the degree of rancidity and provides a measure of the prospective life of the product. It also shows the influence of air, light and time on the oil and measures the amount of oxidation due to these factors at any specific time.

Total titratable acidity (TTA) of bottle stored salad cream ranged from 0.11 to 0.40%, while the plastic stored cream ranged from 0.09 to 0.39% with the potato salad cream as the lowest and the control commercial salad cream as the highest. This finding falls within the report of Eke-Ejiofor and Owuno (2014), with TTA of 0.02 to 0.89 for cassava and potato starch based salad cream.

Free fatty acid (FFA) ranged from 0.13 to 1.52% in bottle stored cream while plastic stored salad cream had FFA range from 0.16 to 2.72% with cassava starch salad cream having the lowest and the control having the highest FFA in both cases. The free fatty acid in this study is lower than that reported by Ogbonnaya and Yahaya (2008), of 0.73 to 2.40 and Eckey (1986) of 0.08 to 6.00, for groundnut and soya oil based mayonnaise. The FFA values for mayonnaise increased as storage weeks progressed indicating the presence of the enzymes lipase. To support the above findings, Brown and Morton (1989) stated that free fatty acid test serves as a quality factor in which its presence in oil is an indication of lipase activity or other hydrolytic action which is important in order to obtain maximum shelf life or storage stability of the finished product.

pH of bottle stored salad cream ranged from 3.75 to 4.95, while the plastic stored cream ranged from 3.78 to 4.81 with cassava salad cream as the lowest in both cases, while three leaf yam based salad cream and control had the highest for the bottle and plastic stored salad cream. Eke-Ejiofor and Owuno (2014) reported a pH of 3.14 to 3.50 in potato starch based salad cream and further stated that pH is an indication of the keeping quality the product.

However moisture content, peroxide value, total titratable acidity, free fatty acid and pH increased significantly ($p < 0.05$) with storage time.

CONCLUSIONS

Salad cream prepared from cassava, sweet potato and three leaf yam starches were stable in storage and did not show any significant difference ($p < 0.05$) in their

Table 3. Storage properties of salad cream stored in plastic container over a period of six weeks.

Sample	Period of storage (weeks)	Moisture content (%)	Peroxide value (mEq/kg)	Total titratable acidity (%)	Free fatty acid (%)	pH
Cassava	0	55.58 ± 1.95^{cde}	1.38 ± 0.28^{h}	0.15 ± 0.00^{fgh}	0.16 ± 0.00^{n}	3.78 ± 0.57^{g}
	2	56.47 ± 0.71^{bc}	1.95 ± 0.07^{gh}	0.17 ± 0.01^{fg}	0.26 ± 0.01^{l}	3.97 ± 0.00^{f}
	4	57.21 ± 0.00^{bc}	2.40 ± 0.15^{fg}	0.17 ±0.00^{ef}	0.39 ± 0.01^{j}	4.38 ± 0.04^{c}
	6	60.85 ± 0.91^{a}	3.84 ± 0.21^{ef}	0.18 ± 0.01^{d}	0.41 ± 0.01^{hl}	4.47 ± 0.01^{bc}
Sweet Potato	0	52.79 ± 0.18^{gh}	3.12 ±0.88^{de}	0.09 ± 0.00^{k}	0.29 ± 0.00^{l}	3.98 ± 0.01^{ef}
	2	52.60 ± 0.32^{efg}	3.44 ± 0.35^{cde}	0.11 ± 0.00^{gh}	0.35 ± 0.04^{k}	3.97 ± 0.04^{f}
	4	53.80 ± 0.32^{defg}	3.94 ± 0.07^{bc}	0.12 ± 0.00^{ij}	0.40 ± 0.00^{l}	4.18 ± 0.01^{d}
	6	53.10 ±0.13^{efgh}	4.35 ± 0.09^{ab}	0.14 ± 0.01^{hl}	0.44 ± 0.01^{h}	4.58 ± 0.06^{b}
Three leaf yam	0	50.65 ± 1.56^{h}	2.79 ± 0.00^{fg}	0.13 ± 0.03^{hi}	0.19 ± 0.03^{m}	4.13 ± 0.01^{def}
	2	51.71 ± 2.26^{gh}	3.31 ±0.01^{cde}	0.15 ± 0.01^{gh}	0.34 ± 0.01^{k}	4.14 ± 0.01^{de}
	4	58.89 ± 0.30^{ab}	3.90 ± 0.01^{abc}	0.17 ± 0.01^{fgh}	0.48 ± 0.01^{f}	4.15 ± 0.01^{d}
	6	55.76 ± 1.05^{cde}	4.82 ± 0.00^{a}	0.19 ± 0.01^{d}	0.51 ± 0.01^{e}	4.18 ± 0.01^{d}
Control	0	39.89 ±1.65^{i}	0.67 ± 0.51^{l}	0.25 ± 0.01^{a}	0.95 ± 0.00^{d}	4.34 ± 0.21^{c}
	2	41.07 ± 2.24^{l}	3.31 ±0.01^{cde}	0.28 ± 0.01^{c}	1.15 ± 0.01^{c}	4.49 ±0.00^{bc}
	4	41.27 ± 0.21^{l}	3.72 ± 0.04^{bcd}	0.36 ± 0.01^{b}	2.66 ± 0.01^{b}	4.49 ±0.07^{bc}
	6	42.73 ±0.81^{l}	3.80 ± 0.02^{bcd}	0.39 ± 0.01^{a}	2.72 ± 0.01^{a}	4.81 ± 0.14^{a}

Means on the same column bearing same superscripts are not significantly different ($p > 0.05$).

storage properties. The salad cream compared favorable with the control in the proximate and storage properties. The storage properties of salad cream in different containers namely bottle and plastic did not differ significantly, meaning that salad cream which is conventionally stored in breakable bottles can also be packaged in high density polyethylene (HDPE) plastic containers which has proved to be void of the problems caused by polyvinyle chloride materials (PVC), and to reduce the issue of breakages without altering the storage properties . It can be concluded that salad cream can be successfully produced from tuber starches.

REFERENCES

Ashaye OA, Lateef SO, Elizabeth AB (2010). Physiochemical rheological and consumer acceptability of cassava starch cream. J. Am. Sci. 6(1):65-72.

Association of Official Analytical Chemists (AOAC) (1990). Official Analysis 15th Edn Association of official Analytical Chemist Washington, D.C.,

Babajide JM, Olatunde OO (2010). Proximate composition, rheology and sensory qualities of corn-cocoyam salad cream. World J. Dairy and Food Sci. 5(1):25-29.

Brown P, Morton ID (1989). Fats and fatty foods, ln; Woolen, A. (Ed). Food Industries Manual Emulsification by mustard species Mill 57:175

Cleese J, Booth C (2001). The complete Fawlty Towers. De Capo press pp. 333.

Compare Materials: HDPE and LDPE. https://www.Makeitfrom.com. Retrieved on 2011-12-30.

Duncan PB (1955). New Multiple Range and Multiple F.-Tests Biometric 11:1-42.

Eckey EW (1986). Vegetable fats and oil. 1st Ed. Reinhold publishing corporatin, New York

Eke-Ejiofor J, Owuno F (2012). Functional and pasting properties of wheat/three-leaved yam (Dioscorea Dumentorcem) Composite flour blend glob. Res. J. Agric. Bio. Sci. 3(4):330-335.

Eke-Ejiofor J, Owuno F (2014). The Functional properties of starches, physicochemical and sensory properties of salad cream from cassava and potato. Int. J. Nutr. Food Sci. 3(6):567-571.

Finberge AJ (1995). Advanced techniques for making mayonnaise and salad dressings. Food Engineering 2:88.

Ogbonnaya C, Yahaya S (2008). Storage stability of groundnut oil and soya oil based mayonnaise. J. Food Tecnol. 6(5):217-220

Osunsami AT Akingbala, TO, Oguntimehin GB (1998). "Effect of storage, starch content and modification of cassava starch. Starch/starke 41:54-57

Pearson D (1990). Chemical analysis of foods. 6th Edn. Churchhill, J.A; Glouceter palace. London. Starch Wikipedia, the free encydopedia assessed on 4/15/2013 2:55pm. Thermoforming HDPE. Dermnet.org.nz

Turgeon SL, Sanchoz C, Gauthier SF, Puguin P (1996). Stability and rehological properties of salad dressing containing peptide fractions of whey protein" Int. Dairy J. 6:645-658.

Typical Properties of Polyethylene (PE). https://www.Ides.com. Retrieved 0n 2011-12-30.

Weiss TJ (1990). Food oils and their uses. 1st Edn. AVI publishing co. Westn Port. Connecticut.