Emulsion produced from fluted pumpkin (telfiaria occidentalis hook f) seeds oil and physico-chemical properties

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Abstract: Oil-in-water emulsion was produced from the oil extracted from fluted pumpkin seeds, the extraction were carried out using two different solvent systems such as normal hexane and petroleum ether separately. Production of oil in water emulsion was also carried out with olive oil as reference standard. The physical and chemical properties of emulsions were determined after extraction of the oil and production of emulsions. The relative density of the emulsion showed that the petroleum ether emulsion were denser 0.93880kg/m3 compare n-hexane emulsion 0.93328kg/m3 and olive oil emulsion 0.93582kg/m3 respectively. The viscosity values of the emulsion, 1.90v was for olive oil emulsion; whilst 1.8v and 1.8v are for n-hexane extracts emulsion and petroleum ether emulsion respectively. The chemical characterization of the emulsions showed acid values of n-hexane emulsion (0.32±0.02mgKOH/g) and petroleum ether emulsion (0.32±0.01 mgKOH/g) respectively. The iodine values of the emulsion, 60.15±0.02 mgI2/g olive oil, n-hexane oil emulsion 73.18±0.02 mgI2/g and petroleum ether oil emulsion 72.81±0.13 mgI2/g respectively. Petroleum ether emulsion 140.4+ 0.20mgKOH/g, which was significantly lower ($p<0.05$) compared to emulsion extracted with n-hexane 148.1± 2.01mgKOH/g Saponification values. Peroxide value of emulsion extracted with n-hexane 0.22+0.02mEq/kg, peroxide value of emulsion extracted with petroleum ether 0.22+0.15mEq/kg and this was not significant ($p<0.05$). This low peroxide values, were observed to be non-significant at 95% confidence interval. This result suggests that emulsions produced from olive oil had microbial load or contamination 6.67x104 cell/ml, while microbial contamination of 2.67x105 cells/ml was detected for N-hexane and pet ether emulsion.

Key words: peroxidation, Emulsion production, saponification and microbial contaminations

1. Introduction

Fluted pumpkin seed oil is widely consumed domestically in Nigeria with little or no considerations on its industrial applications. However, an investigation on the properties of emulsions produced from this novel seed oil build upon this topic. Wherein, the importance of emulsion production from this novel seed crop in the economic growth of developing countries has been overlooked because as a result, most of the lipid and emulsion products are been imported. Lipids has played vital role in the industrialization of a nation (Adeleye *et al*, 2003). The seeds are consumed in Nigeria, especially in the southern part of Nigeria where it is used as soup condiment (Christian, 1996). The fermented seeds are also used in formulation of marmalade and cookies (Fagbemi, *et al*, 2005, Tedong, *et al*, 2010). The seeds serve as good source of edible oil. While the crude protein and fat content of the seed, are sources of vitamin A and C. The mineral composition of the seed has been reported (Smith, *et al*, 2006). However, in depth studies on the industrial application of the oil, especially with regards to emulsion production has not been fully reported. In this study, the production of stable emulsion from fluted pumpkin seed oil extracted with two different solvents system was investigated to provide useful information for nutritionists, emulsion producers and consumers on the possibility of producing stable emulsions from pumpkin seed oil.

Fluted pumpkin (*Telfairia occidentalis)* is a tropical plant growing in some parts of West Africa as a leafy vegetable and for its edible seeds. Common names associated with the plant include: fluted gourd and fluted pumpkin. While in some parts of Nigeria, it is locally called: *Ugu*, among the Ibos in Nigeria, *edikangikong* in Efik language Calabar Nigeria. The Hausa speaking people call the vegetable ugwu, while it is known among the

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Yoruba people as efuru. The plant is drought-tolerant, dioeciously perennial, i.e it is usually grown trellised (Agatemor, 2005). The shoots and leaves of the female plant are the main ingredients for a Nigerian soup. The large dark-red seed is rich in fat, protein and can be eaten whole or grounded into powder/paste for soup making and made into a fermented porridge (Sokeng, *et al*, 2007). Fat emulsion for parenteral nutrition, an area which has been poorly neglected is the harnessing of fats for use as fat infusions. The fat emulsion can serve as an important nutrient source for patients where oral feeding is difficult (Ramesh, *et al*, 2006). Generally, the most important sources of energy are carbohydrates and fats, and where oral feeding is insufficient or difficult, the energy yielding nutrients have to be delivered intravenously or parentally. In such situations fat emulsions are used because it is difficult to infuse the required amount of energy in the form of carbohydrates. The bulk of carbohydrates that will be involved will be large. This plant can be propagated by seed; it strived on both (dry and wet) seasons, but grows better in raining season. It can be attacked by larvae from the cotton leaf roller (S*ylepta derogate*) which feed on the leaf (Vertuani, *et al*, 2004). Other diseases that usually affect the plant are caused by s*Rhizopusstolonifer, Aspergillusnigerang and Erwinia spp* (Nwufoa, and Emebiria, 1990).

2. Methodology

2.1. Plants materials

Fluted Pumpkin seeds: The fluted pumpkin (*Telfairia occidentalis* hook f) seeds used for this research were purchase from Nsukka area of Enugu State, Nigeria, and identified by: Mr. O. U. Ozioko of Bio-resource Development and Conservation Programme (BDCP). Resource Centre, Nsukka.

2.2 Chemicals

All chemicals used were of analytical grade and are products of British Drug House (BDH) Chemical limited, Poole England.

2.3 Preparation of seeds

The fluted pumpkin (*Telfairia occidentalis* hook f) pods were cut open to remove the seeds.
The seeds were washed with clean water and rewashed with distilled water to remove dirt's. The wet seeds were dihulled with a knife, after which the wet seeds were dried in an oven at 40^{o}C for 72 hours. The low temperature was to prevent the evaporation of volatile oil and denaturation of constituents in the oils. The seeds were grounded to coarse particles and used for extraction.

2.4 Extraction of oils from the samples

The extraction was done by soxhlet extraction method. The solvents used for the extraction of oils are n-hexane and petroleum ether of boiling temperature ranges 40^{o}C -60 ^{o}C. A quantity 500g of each sample was weighed and carefully packed into a soxhlet apparatus and the oil extracted.

2.5 Recovery of oil from solvents

The solvents mixture (n-hexane and petroleum ether) containing the oil and extracting solvents were separately dried using a rotary evaporator which was heated in a water bath. The concentrated oils were placed in an oven at 40oC overnight to evaporate every trace of solvents.

3 Statistical analysis

All investigations were carried out in triplicate and data obtained were presented as mean ± standard deviation using descriptive statistics. Student T – test was used to compare mean variance. Significance was accepted $p<0.05$ using SPSS v16.

4 Results

4.1. Physical properties of fluted pumpkin oil in-water emulsions

Results of the physical properties of fluted pumpkin seed oil emulsions extracted with n-hexane, petroleum ether and olive oil emulsions are shown in table 1. Result Show that emulsion of petroleum ether extracts had a

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higher relative density than n-hexane oil extracts emulsions and olive oil emulsions. Their viscosity also differed, as well as their refractive index.

Table 1 Physical properties of fluted pumpkin oil in-water emulsions

Oil samples	Density (kg/m^3) At 25^oc	Viscosity (v)	Moisture content (%)
Olive oil (standard)	0.93582	1.90	0.41
Oil extracted with n-hexane	0.93328	1.89	0.41
Oil extracted with petroleum ether	0.93880	1.89	0.44

Reference standard oil

Table 2 Physical and microbial properties of emulsions

Table 2 showed the results of internal properties of emulsions.
The emulsions differed in their colours, microbial load and pH but had the same odour and taste.

Oil samples	Colour	Odour	Taste	pH	Microbial contamination (cell/ml)
Olive oil (standard)	White	Odourless	Tasteless	8.01	$6.67x10^4$
Oil extracted with n-hexane	Brown	Odourless	Tasteless	8.03	$2.67x10^5$
Oil extracted with petroleum ether	Brown	Odourless	Tasteless	8.02	$2.67x10^5$

Reference standard oil

Table 3 Showed the result of the Chemical Properties of Fluted Pumpkin Seed oil Emulsions (*Telfiaria occidentalis* hook f).

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The results showed that acid values, peroxide values, and iodine values of emulsion were not significantly different. Their saponification values however were different with that of the olive oil emulsions being higher.

Table 3 Chemical properties of fluted pumpkin oil-in water emulsions

oil samples	Acid value (mgKOH/g)	Peroxide value (Meq/g)	Iodine value (mgI_2/g)	Saponification value (mgKOH/g)
olive oil (standard)	0.24±0.01	0.20±0.10	60.15±0.02	149.3±0.10
Oil extracted with n-hexane	0.32±0.02	0.22±0.03	73.18±0.02	148.1±2.01
Oil extracted with petroleum ether	0.32±0.01	0.22±1.05	72.81±0.13	140.4±0.20

Reference standard oil
All results are mean ± SD for 3 determinations

5 Discussion

Oil was extracted from fluted pumpkin *(Telfiariaoccidentalis* hook f) seeds, using two different solvents system, and n-hexane and petroleum ether whilst olive oil was used as reference oil for production of emulsion. The relative density of the emulsion showed that the n-hexane extracts was denser at 0.93328kg/m^3, this suggests that n-hexane extracted total lipid components from the seeds than petroleum ether. There is no significant difference in the viscosity of emulsion at 1.90v olive oil emulsion; 1.8v and 1.8v for n-hexane extract emulsion and petroleum ether extract emulsion respectively, indicating that the olive oil emulsion were more viscose than the extracted oil emulsions. This can be possible due to low temperature experience in olive oil emulsion and purity. The moisture content of the emulsion was 0.41 for all the extracted oil emulsions. This is in line with (Chanamai, and McClements, 2001 and McClements, 1998). They stated that the physical properties of some oils in water emulsion do not differ, and even if they do, it's not significant at confidence interval as shown in table 1. The chemical characterization of the emulsions showed acid values of n-hexane extract (0.32±0.02 mgKOH/g) and petroleum ether (0.32±0.01 mgKOH/g) respectively. The iodine values of the emulsion, were almost the same, they ranged from olive oil emulsion 60.15±0.02 mgI_2/g, n-hexane oil emulsion 73.18±0.02 mgI_2/g and petroleum ether oil emulsion 72.81±0.13 mgI_2/g respectively. The high iodine value indicates that the oil used for the production of emulsion was unsaturated and explains the degree of flow. The saponification value of emulsion extracted with petroleum ether had 140.4± 0.20mgKOH/g, which was significantly lower ($p<0.05$) when compared to emulsion extracted with n-hexane which had 148.1± 2.01mgKOH/g. The evaluation of saponification values of the oil extracts indicates the molecular weight of the emulsion, suggesting that the n-hexane emulsion extracts has shorter chain fatty acids components (Jordanov, et al, 2005). The extracts with lower saponification value have higher molecular weight as can see in table 3. The high saponification value may be connected to the nature of the oils and the metallic ion present among other factors (Gray, 1978); Magnus, 1992 and Nkafamiya, et al, 2007a). The peroxide value of emulsion extracted with n-hexane 0.22±0.02mEq/kg was low compared to the peroxide value of emulsion extracted with petroleum ether 0.22±0.15mEq/kg and this was not significant ($p<0.05$). This low peroxide values were observed to be non-significant at 95% confidence interval and suggest little or no proxidative rancidity of the oil in water emulsion, probably because the seeds were fresh, proper handling of the oil during extraction was ensured, and the hygiene process of producing the emulsion. The result of the peroxide values may also be due to absolute removal of moisture from the emulsion and seeds, since high peroxide value is associated with moisture content, atmospheric oxygen and light on

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the oils which can leads to progressive increase in peroxide value. The bulk properties of emulsions and the initial state of the emulsion are defined by a set of internal parameters. Some of the bulk parameters used to describe the state of an emulsion is droplet size and concentration (Egbekun, *et al*, 1998). Thus, the bulk properties of emulsions such as color, texture and taste are primary function of these two colloidal parameters (McClements, 1998). Other properties such as pH and microbial contamination can further define the initial state of emulsions as shown in table 2. This result also showed that emulsions produced from olive oil had the least microbial load or contamination $6.67x10^4$ cell/ml compared to fluted pumpkin seed oil, this suggest that olive oil is refined while oil extracted from fluted pumpkin seeds is crude. Oil extracted with petroleum ether and hexane had the same microbial contamination 2.67×10^5 cells/ml. The essential part of this research is the precise determination of density where small temperature fluctuations can result in large errors in calculating densities of emulsion. Though, temperature affects the stability of emulsions, we do not feel it was the only factor as some other factor may contribute to destabilization.

This result indicate that the shelf life of olive oil emulsions is least affected by bacterial growth. And its shelf life can be extended. Compared to the emulsions produced from oils extracted with n-hexane and petroleum ether. However, the major organism that grows prominent in the emulsion was identified to be E-*coli*. The implication of the presence of this organism in emulsion is that it promotes rancidity and facilitates destabilization of emulsion. The effect of temperature on emulsion density, this illustrate that the density of emulsion does not destabilize spontaneously at different temperature. Instead, the emulsions disintegrate gradually with response to variable temperature; table 2 indicates that at 70^oC to 80^oC, the emulsions density decreases rapidly due to increase in temperature (Becher, 2001). Suggesting that temperature increase, while the emulsion losses its integrity momentarily.

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