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Hypothesized biochemical modes of action of palm oils used in ethno-medicine

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ABSTRACT:

The biochemical modes of action of palm oil (PO) and palm kernel oil (PKO) that are used in ethno-medicine were hypothesized. One thousand randomly selected families in the southeastern and southsouthern parts of Nigeria were used in a face-to-face interview questionnaire-based ethno-medical survey on the use of the palm oils and the ointments made from them to treat infections and febrile seizures in ethno-medicine. The presence of bioactive phytochemical and biochemical constituents with the desired pharmacological activities was detected and their biochemical modes of action hypothesized. When PKO is used to treat febrile seizures, transdermally transported antipyretic agents inhibit the expression or activities of cyclooxygenase (COX) isoforms. In conclusion, the hypothesized modes of action are that the oils are antimicrobials and increase trans-dermal transport of bioactive agents.

Keywords:
Biochemical, ethno-medicine, hypothesis, modes of action, palm oil, palm kernel oil.

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INTRODUCTION

Fruits of tropical palm tree (*Elaeis guineensis* Jacq.) yield two types of oils. The palm fruits are cooked, mashed and palm oil (PO) pressed out and the kernels fried or crushed and pressed for palm kernel oil (PKO) (Ekwenye and Ijeomah, 2005; Ugbogu *et al*., 2006). In ethno-medicine, PO is mixed with the acid salt, sodium sesquecarbonate ($Na_2CO_3.NaHCO_3.2H_2O$; *Akanwu* in Igbo) to treat skin diseases on domestic animals. On the other hand, PKO is mixed with ground wet or dried leaves of *Ocimum gratissimum* (scent leaf) to treat febrile seizures (C. Ibegbulem, personal communications). Ugbogu *et al*., (2006) had reported the anti-microbial roles of PKO against *Staphylococcus aureus* and *Streptococcus* specie.

Traditional medicine provides most of the health-care needs of most rural dwellers in Nigeria. This involves the use of local gin, oils and assorted local herbs (Ekwenye and Ijeomah, 2005). The biochemical basis for the modes of action of the plant materials used in ethno-medicine is not understood. It is thought that their phytochemical and biochemical constituents may be responsible for their acclaimed effects. This study carried out a randomized, face-to-face interview, questionnaire-based ethno-medical survey on one thousand randomly selected rural families in some southeastern and southsouthern states in Nigeria on the use of PO and PKO and their ointments in ethno-medicine. The oils were screened for the presence of bioactive phytochemical and biochemical constituents with the desired pharmacological actions and anti-microbial tests were carried out using the oils and their ointments. Such information was then used to hypothesize their biochemical modes of action.

MATERIALS AND METHODS

Procurement of samples

The refined PKO used in the study was purchased from Camela Vegetable Oil Limited, Irete-Owerri, Nigeria. Fresh PO, *Akanwu* and *O. gratissimum* were purchased from Nkwo-Ukwu Market, Ihiagwa, Nigeria. The *O. gratissimum* leaves were authenticated by Dr. F.N. Mbagwu, a taxonomist at the Department of Plant Science and Biotechnology, Imo State University, Owerri, Nigeria. Voucher specimen was deposited; with number: IMSUH 029.

All the chemicals used were of analytical-reagent grade and were purchased locally.

Ethno-medical survey

The survey was carried out on one thousand randomly selected rural families, many of who rely on PO, PKO and their ointments in ethno-medicine as home-made remedies (including those of traditional medicine practitioners) in the southeastern and southsouthern parts of Nigeria, using face-to-face interview-based questionnaires. This method was used because most of the rural families interviewed are illiterates and there was need to create the conducive environment for them to freely air their views without restrictions. The survey entailed (i) confirmation of the use of the oils in ethno-medicine (ii) most popular combinations (if any) (iii) major types of ailment treated with each sample and (iv) knowledge of biochemical mechanism other than the efficacy.

Qualitative analysis for phytochemical and biochemical constituents

Tests for the presence of tannins, flavonoids and catechins were determined according to the methods of Evans (2002). Saponins were detected using the frothing and red blood cell haemolysis tests described by Harborne (1973). Test for the presence of lipid was carried as described by Plummer (1971). Test for the presence of 4-methyl hydroxyl benzoic acid (4-MHBA) was carried out using the method of ASEAN (2005).

Treatment of sample and preparation of ointment

A quantity (5.0 ml) of PO was mixed with 3.0 g of ground *Akanwu* while 5.0 ml of PKO was mixed with

Table 1: Ethno-medicine, ailment treated, response to ethno-medical usage and scientific data

Ethno-medicine	Ailment treated	Ethno-medical survey usage (%)*	Scientific data on usage
PO	Skin infection	93	Ekwenye and Ijeomah (2005)
PKO	Skin infection	96	Ekwenye and Ijeomah (2005); Ugbogu *et al*., (2006)
PKO and *O. gratissimum* ointment	Febrile seizures (convulsion)	98	NA
PO and *Akanwu* ointment	Skin infection on domestic animals	72	NA

***Responses are of 1000 families (including those of traditional medicine practitioners).**
Key: NA = not available.

3.0 g of sun dried and ground leaves of *O. gratissimum*.

Microbial culture and sensitivity tests

The pathogenic *Pseudomonas aeruginosa* and *Staphylococcus aureus* bacteria used were obtained from degenerated wound. Isolates were purified on nutrient agar (Fluka) plates and characterizations were done using standard microbiological methods. Identification to the generic level was carried out using the methods of Holt *et al*., (1994). The microbial culture and sensitivity tests were carried out using the oils and their ointments as described by Ekwenye and Ijeomah (2005) using the disc diffusion method.

RESULTS AND DISCUSSION

The ethno-medical importance of the oils was confirmed in the survey (Table 1). Usage of some of them had also been confirmed by scientific data. The responses were influenced by the use of alternative traditional and orthodox medicines and occurrence of the ailment so treated.

The desired phytochemicals and biochemicals detected in our samples are presented in Table 2. Ibegbulem and Chikezie (2012) had also reported the presence of these phytochemicals and biochemicals in PO and PKO. Table 2 also shows that the oils had property of antimicrobial agents because they contained phytochemicals and biochemicals with reported antimicrobial and antioxidant property. Tannins, saponins and flavonoids have been reported to have antimicrobial and antioxidant properties (Evans, 2002). The paraben, 4-MHBA, is also an antimicrobial agent (Zimmer and Huyck, 1961). The lipid detected in the oils and ground *O. gratissimum* may have been composed of different fatty acids. Wardlaw and Kessel, (2002) reported that palmitic acid is the major fatty acid in PO while lauric acid is the major fatty acid in PKO. The composition of the lipid in *O. gratissimum* is suggested for further studies.

The palm oil and PKO used did not inhibit the growth of the test microorganisms (Table 3) possibly due to their limited solubility and diffusions into the agar edia. Ekwenye and Ijeomah (2005) reported the same observations. These observations do not however preclude the fact that the oils are used in ethno-medicine for treating infections. It may be that their phytochemical and biochemical contents were not enough to inhibit the growth of the test microorganisms. Again, the test microorganisms may have been more resistant because

Table 2: Phytochemical and biochemical constituents of pharmacological importance*

Parameter	Sample‡		
	PO	PKO	*O. gratissimum*
Tannins	+	+	+
Flavonoids	+	+	+
Catechins	+	+	+
Saponins	+	-	+
Lipid	+	+	+
4-MHBA	+	+	+

***Values are mean of triplicate determinations. ‡Water soluble fraction. Key: + = detected, - = not detected.**

Table 3: Sensitivity tests using oils and ointments

Sample	Microorganism	
	Pseudomonas aeruginosa	***Staphylococcus aureus***
PO	-	-
PKO	-	-
PO and *Akanwu*	+	+
PKO and *O. gratissimum* ointment	+	+
4-MHBA	+	+

Key: + = sensitive; - = insensitive

they were hospital isolates; being more resistant than environmental isolates. However, the ointments made from the oils had antimicrobial effects (Table 3). The ground *O. gratissimum* leaves contained all the phytochemicals and biochemicals detected in the oils (Table 2), so, its effect may have been additive. The oils may also have been emulsified by the *Akanwu* and ground *O. gratissimum* thereby increasing their solubilities. Traditionally, ointments made from these oils are more potent than just the oils and may justify their usage amongst the populace in some parts of Nigeria. Ugbogu *et al*., (2006) reported that lauric acid is the antimicrobial agent in PKO and that the antimicrobial effect of fatty acids are additive.

Though we did not prove the antipyretic property of the PKO-based ointment here, the biochemical mechanisms were however suggested. The hypothesis was based on the presence of bioactive principles of pharmacological interest (Table 4). Most of their acclaimed effects had been confirmed by empirical evidence (Table 1).

Febrile seizures occur between the ages of six months and six years in children when the body temperature exceeds 38^{o}C (http://en.wikipedia.org/wiki/Febrile_seizure). The antipyretic nature of the unctuous PKO-based ointment, which is rubbed on the body, soles, palms and into the rectum of patients, stems largely from the ability of the fatty acid contents of the oil to increase the percutaneous absorption of the antipyretic agents contained in the febrifuge (like *O. gratissimum*). Fatty acids like myristic, capric, oleic and lauric acids increase transdermal delivery of highly lipophilic drugs (Pathan and Setty, 2009). Antipyretic agents inhibit the activities of cyclooxygenase (COX) isoforms thereby reducing the concentration of prostaglandin E_2 within the hypothalamus which cause the elevation of body temperature (Aronoff and Neilson, 2001). Flavonoids like wogonin, anthocyanidins, cyanidin, delphinidin have been reported to inhibit the expression of COX-2 genes (Hou *et al*., 2005; Chen *et al*., 2008) while baicalin and catechin inhibited the expression of COX-1, COX-2 and 5-lipoxygenase (5-LOX) genes in dogs (Burnett *et al*., 2009). The antipyretic properties of *O. suave* and *O. lamiifolium* have also been reported (Makonnen *et al*., 2003). The very high body temperatures that are the cause the seizures are commonly lowered by tepid sponging, which principle is based on latent heat of vaporization.

Table 4: Suspected bioactive principle in ethno-medicine

Sample	Ailment treated	Suspected bioactive principle*
PO	Skin infection	Lipid, tannins, flavonoids, saponins, 4-MHBA
PKO	Skin infection	Lipid, tannins, flavonoids, saponins, 4-MHBA
PKO and *O. gratissimum* ointment.	Febrile seizures (convulsion)	Lipid, flavonoids (catechins)
PO and *Akanwu* ointment.	Skin infection on domestic animals	Lipid, tannins, flavonoids, saponins, *Akanwu*, 4-MHBA

***Based on Table 2.**

CONCLUSION

In conclusion, we hypothesize that when PO and PKO and their ointments are used to treat infections, their phytochemical and biochemical constituents inhibit microbial growth. When their oinments are used to treat febrile seizures, they increase percutaneous absorption of antipyretic agents which inhibit the expression or activities of COX isoforms.

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