



Original Research Article

Evaluation of antioxidant potential of *Monodora myristica* (African Nutmeg)

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A B S T R A C T

Keywords

Monodora myristica, oil; free fatty acid; thiobarbituric acid; reactive oxygen specie; acid value; palm oil; palm kernel oil; peroxide value.

This work evaluated the antioxidant potential of *Monodora myristica* (African nutmeg). *Monodora myristica* extract was obtained through solvent extraction using n-hexane and used as treatment on freshly prepared crude palm kernel oil and palm oil. Equal volume of oil samples were subjected to different concentrations of extract treatment (0.2ml, 0.4ml, 0.6ml, 0.8ml, 1.0ml). These oil samples were equally divided into two groups SS (stored under sun) and SR (stored under room temperature). Group SS was stored under the sun and group SR was stored under room temperature for three weeks. These treated oil samples were analyzed on weekly basis at two different parameters: Acid value (AV) of free fatty acid and thiobarbituric acid (TBA) value, using standard methods. The main effect of extract was determined using ANOVA. For the two varieties of oil, the acid value of free fatty acid increased significantly ($P < 0.05$) as the period extends for group SS without extract while those for group SR showed no significant increase. But AV of oil samples treated with higher extract concentration decreased significantly ($P < 0.05$) for both groups SS and SR. TBA value also showed the same trend of AV. Hence, *Monodora myristica* extract yielded reducing effect in the oxidative level of the oil varieties

Introduction

Monodora myristica is a widespread and attractive small tree with very decorative flowers appearing just before the leaves. The fruit is suspended on a long green stalk with numerous seeds embedded in whitish sweet smelling pulp. The seed is

oblong and pale brown when fresh with a thin seed coat and hard kernel (Okafor, 2003). The seed production is seasonal occurring between April to June. The fruits are globular and ovoid; 3-4 inch long and about 3-5 inch diameter. The wood is

hard. The seeds are contained in a hard shell and have a very strong aroma. This plant is commonly called Orchid flower tree in English, 'Ehuru Ofia' in Igbo (Okafor, 2003). *Monodora myristica* is a specie of calabash nutmeg, the edible seeds yield a nutmeg-flavoured oil which is used in West Africa for cooking (Eggeling, 2002). *Monodora myristica* seed extract contains important pharmacological compounds like alkaloids, flavonoids, and vitamins A and E as well as many important lipids. Traditionally, the plant is widely used especially to relieve toothache as well as in the treatment of dysentery. When roasted and ground, the seeds are rubbed on the skin for (unspecified) skin diseases (Irvine, 2000). This suggests that the seeds of *Monodora myristica* plant could be germicidal or antiseptic. The roasted ground seeds are chewed, spat into the hand and then rubbed across the forehead to relieve headache. The seeds are also crushed and used as insecticide, while the root relieves toothache when crushed (Oguntimein *et al.*, 1999).

The seeds of *Monodora myristica* are also used for the treatment of constipation and as a stimulant (Irvine, 2000). Essential oil's from the seed is used in pharmaceutical and dental preparation (Talalaji, 1999). Nutmegs are tropically distributed. It is called *ehuru* or *ehiri* in Igbo language in the south east part of Nigeria. The *Monodora* species are also found in West Africa and are cultivated in the southern parts of Nigeria (Okafor, 2003). The trees are very common in the south east and south-south regions of Nigeria. The seeds and seed coats of the plant are used as a spice. Once dried these have an aroma reminiscent of nutmeg and are sold whole to be grated as a nutmeg substitute (Talalaji, 1999). Calabash

nutmeg has a nutmeg-like flavour with a pungent overtone. The whole seed coat and seed is either ground and used as a seasoning for West African soups or stews or is ground and used as a nutmeg-like flavouring in cakes and desserts.

Palm oil is a produce from the fruit and kernel of the palm tree. The fruits are first collected and pressed, yielding a rich, dark-red oil which is high in carotene (Pantzaris and Ahmad, 2004). Palm kernel oil (PKO) is obtained from processing the kernel from the fruit of the oil palm tree (*Elaies guineensis*). Palm kernel oil has similar uses to coconut oil owing to their similarity in composition (Pantzaris and Ahmad, 2004). PKO is gotten from the kernel of the palm fruit and it is located inside the hard shell while the outer fleshy mesocarp gives palm oil (Nyam *et al.*, 2009).

Lipid oxidation is one of the major reasons that food deteriorate and is caused by the reaction of fat and oil with molecular oxygen, leading to off-flavours that are generally called rancidity (Basturk *et al.*, 2007). Rancidity is associated with off-flavour and odour of the oil. There are two causes to rancidity. One occurs when oil reacts with oxygen and is called oxidative rancidity. The second cause is by the combination of enzymes and moisture. Enzymes such as lipase liberate fatty acids from triglycerides to form di- and/or monoglycerides and free fatty acids and such liberation of fatty acid is called hydrolysis, hence hydrolytic rancidity. Oxidation is concerned mainly with unsaturated fatty acids. Oxidative rancidity is of special interest as it leads to the development of off-flavour that can be detected early in the development of rancidity (Basturk *et al.*, 2007). Oils in general are known to be susceptible to

oxidation and microbial attack. The composition of the various oils determines the extent of oxidation and type of organisms likely to thrive in them (Chow *et al.*, 2000).

This study is aimed at examining the oxidative and biodeteriogenic effects of free radicals contaminating the oils from the varieties of the oil palm (*Elaeis guineensis*) and palm kernel oil and the chemical components of the oils and the effect of solvent extract of *ehuru* (African nutmeg). Lipid oxidation and resultant flavour impairment has seriously limited the storage potential of most oil containing food (Ihekoronye and Ngoddy, 1985). Lipid oxidation generally occurs after a long induction period. Once started it is generally a very rapid reaction and proceeds by a free radical mechanism.

General review of phytochemistry of *Monodora myristica*

Alkaloids

They are a group of basic secondary plant substance, which usually possesses an n-containing heterocycle. Alkaloids exist in plants as salts, amine or n-oxides. Dicotyledonous plants are the real producers of alkaloids (Evans, 1989). They appear in large members and in many variation in these plants. They are bitter to taste, so when present in plants, insects and predators tend to move away from such plants. They also protect the plant from the effect of singlet oxygen (Bonner and Varner, 1965). Alkaloids at high concentration, produce a variety of toxic effects on animals. Their pharmaceutical and medicinal importance can be seen to act on the cardiovascular system and some have been resorted to be antihypertensive.

Glycosides

These are the products obtained after condensation of sugar with different types of organic hydroxyl compounds. These are referred to as the cardiac-active or cardio-tonic glycosides examples include amygdalin. In small doses, glycosides promote mild gastric irritation causing a reflux from the bronchioles. This can be attributed to its wide usage but in larger dose, they lead to vomiting (Evans, 1989). A larger number of glycosides and their aglycone have antimicrobial activities.

Saponins

Saponins are useful in the production of soft drinks, beers, confectioneries, shampoos, soaps, fibre extinguishers and beverages and this is attributed to its foaming ability. They are quite toxic when injected into the bloodstream and are harmless when taken by mouth since the sarsaparilla is rich in saponins but is used in the preparation of non-alcoholic beverages (Evans, 1989). The highest saponin concentration occurs in the reproductive parts of the plants, the seeds containing 18% trigonin (Bonner and Varner, 1965). Saponin have some medicinal properties, since it has been reported to have anti-inflammatory, anti-fungal, antimycotic, bacteriostatic and other biological activities.

Tannins

The word "tannin" signifies substances present in plant extracts, which are able to combine with protein of animal hides, prevent their Putrefaction and the conversion to leather (Evans, 1989). Those tannins are responsible for the taste qualities of wines, tea and coffee. They are astringent and styptic (i.e. the dry sensation

felt in the mouth). Tannins due to their antiseptic properties prevent fungal attacks (Bonner and Varner, 1965; Evans, 1989).

Applications of vegetable oils

Many forest trees produce seeds that contain fatty oils; these can be processed into vegetable oils for use in cooking, food industry and soap-making, and also as fuel. Producing fixed oils is a simple process and can be done locally, with locally made equipment. In the first stage, the oil is extracted from the seeds by dry expression or by boiling the crushed raw material in water. Vegetable oils also provide inputs to the more complex detergent industry, which uses fatty alcohol derivatives of lauric oils, which currently come mainly from palm kernels - primarily coconut (*Cocos nucifera*) and African oil palm (*Elaeis guineensis*).

Palm oil is processed to produce edible fats (margarine), soaps and candles and is used in pharmacy and cosmetics and as an important raw material in oleochemistry (fat chemistry). Palm kernel oil (PKO) is more unsaturated and hence can be hydrogenated to a wider range of products which could be used either alone or in blends with other oil for biscuit dough, filling creams, cake icing, ice cream, imitation whipping cream, substitute chocolate and other coatings, sharp melting and melting margarines etc. Lauric oil (CNO, PKO) is very important in soap making and a good soap must contain at least 15% lauric acids for quick lathering while soap made for use in sea water is based on virtually 100% lauric oils.

Mostly palm kernel oil are now used for the manufacture of short chain fatty acids, fatty alcohols, methyl esters, fatty amines,

for use in detergents, cosmetics and many other cosmetic products but less consideration is given it for other purpose. *Monodora myristica* seed are used as condiment in West Africa, a decoction of the seed is used to treat guinea worm infection. The seeds are used as a remedy for constipation, when mixed with palm oil. Roasted and powdered seeds of the plant are very effective in curing stomach ache. The seeds are rubbed on the forehead to cure headache (Gill, 1992).

Materials and Methods

Procurement of Raw Materials

The selected indigenous spice, African nutmeg (*Monodora myristica*) was purchased from Ogbete main market in Enugu state of Nigeria. Identification and its authentication were carried out by Dr Charles Ishiwu of Department Of Food Science And Technology, University of Nigeria, Nsukka and also a senior lecturer in Biochemistry Department of Caritas University, Enugu state.

Once purchased, the spices were collected into sterile glass desiccators and stored in an oven maintained at 70°C until use. The spices (dried samples) were estimated to have been in the market for 6-7days before purchase.

The varieties of vegetable oil used palm kernel oil and palm oil were processed and obtained from Aniuzo International Limited (Palm Kernel oil Mills Division), Emene in Enugu state and Anieke Palm oil Mills, Ubulu-uku in Delta state. These were done in large quantity to minimize chances of variation and to maintain experimental homogeneity in sample selection

Study design

This study was conducted on two different varieties of vegetable oil (palm kernel oil and palm oil). Each of the varieties was divided into two groups A and B. Group A was exposed to adverse tropical conditions under the sun, while Group B was kept indoors. There were 6 samples of equal volume for each group of each variety of oil. Five (5) of the samples contain different concentrations of African nutmeg extract at 0.2ml, 0.4ml, 0.6ml, 0.8ml, and 1.0ml concentrations, and one (1) contains no extract. Therefore, there were total of 12 samples for each variety. The study was conducted for 0, 1, 2, and 3 weeks. Each sample was analyzed in triplicates and the mean was used in final content calculation. All experimental procedures were carried out simultaneously under the same condition used for storage.

Sample preparation

The method of AOAC (1990) was used. The African nutmeg seeds were heated in an oven (hot air) at 105°C (for easy extraction of the oil). They were then weighed in the digital weighing balance and grounded using spiral grinder. The freshly collected seeds of the *Monodora myristica* were sun dried and powdered using a pestle and mortar. The powder was defatted with n-hexane (65 - 69°C) using Soxhlet apparatus. The whole filtrate was allowed to evaporate at room temperature leaving the oil.

Chemical analysis

Determination of Acid Value (AV)

The free fatty acid content of a fat/oil is the number of milligrams of KOH required to neutralize one gram of free

fatty acid present in fat/oil sample. The acid value is the number of milligrams of KOH necessary to neutralize the free acid in one gram of sample. The acid values (MgKOH/g) of the oil samples were determined according to Polish Standard (PN-EN ISO 660:2005). Weighed samples of around 20 g were dissolved in 100 cm³ of ethanol: diethyl ether mixture (1:1, v/v) and titrated with 0.1 N potassium hydroxide solution using phenolphthalein as an indicator. Analyses were carried out in triplicate the acid value is the mg KOH used to neutralize 1.0 g of each oil sample. Results were used as reference data for model building. The acid value is given by $T - B \times 5.61/W$ where 0.1M KOH contains 5.6mg/ml or 5.6g/l where T=Titre value of the sample; B=Titre value of a blank. The blank was provided as a control by titrating 2.5ml of the neutral alcohol without sample. The free fatty acid (FFA) is normally determined as oleic acid where by the acid value = 2 x FFA.

NaOH may be used and a generalized formula may be used (for palm oil and fractions): $25.6 \times M_{NaOH} \times V/W$ where V= Volume of NaOH solution used in ml; W=Weight of sample.

Determination of Thiobarbituric Acid Number (TBA)

The thiobarbituric acid value TBA was determined by modification of method described by Odo and Ishiwu, (1999), the PORIM Test Method. Thiobarbituric acid value TBA is the intensity of pink pigment formed between 2-thiobarbituric acid and the oxidized lipid measured optically in a colorimeter. This has been found to increase as oxidation advanced. Malonaldehyde is probably involved in the reaction (Odo and Ishiwu, 1999). Ten gram (10g) of the sample is added into

50ml distilled water in a distillation flask and 2.5ml of 4M HCl is added to raise the pH to about 1.5. Then antibumping granules are added and the distillation kit is set up. The mixture is heated in a heating mantle such that 50ml distillate is collected in 10minutes from the time boiling started. 5ml of the distillate and 5ml of TBA reagent (0.288g/100ml) of glacial acetic acid were added into a stoppered tube and heated in a boiling water bath for 35minutes. Blank determination was made using 5ml of distilled water and 5ml reagent. The tubes were cooled in running water and the reading of the absorbance against blank was taken at 538nm.

Statistical analysis

All statistics were performed using Analysis of Variance (ANOVA) version 2007 software.

Results and Discussion

The mean acid value (AV) for free fatty acid and thiobarbituric acid (TBA) values of tested oil sample are shown in Tables 1 - 4, respectively. Data for the tested oil samples were obtained by measuring samples from the same producer in triplicate. Mean values in Table 1 - 4 are followed by lists those pairs of weeks, between which statistically significant difference exists. Tables 1 and 2 respectively showed the Acid Values (AV) of free fatty acid, while tables 3 and 4 showed the thiobarbituric acid values (TBA) of crude palm kernel oil and palm oil stored with varying concentration of 0.2%-1.0% of n-hexane extract of *Monodora myristica* seed, stored in the sun and in the room. The trend observed above for AV was also the same with that of TBA in all the storage conditions only

that the AV values were higher than that of TBA. Ihekoronye and Ngoddy (1985) reported that the AV of any lipid were both measure of hydrolytic rancidity and that the lower their values, the slower was the rate of hydrolytic rancidity. Hence crude palm oil stored with varying concentration of 0.2%-1.0% extract of *Monodora myristica* seeds were less prone to oxidative rancidity. This showed that the extracts at varying concentration demonstrated high antioxidant activity. However the antioxidant activity was higher as concentration of *Monodora myristica* extract increases at both environmental conditions.

We can note that unsaturated fatty acid content drops with the time of addition of extract then is stabilized from the first week. This fall is felt much in the case of the crude palm kernel oil. It would be due to the fact that when the oil samples are exposed to the sun and in the free air, their unsaturated fatty acids fix oxygen and oxidize. From the values deduced from thiobarbituric acid TBA evaluation, the trend is similar to that of acid value

For the two varieties of oil, the acid value of free fatty acid increased significantly ($P<0.05$) as the period extends for group SS without extract while those for group SR showed no significant increase. But AV of oil samples treated with higher extract concentration decreased significantly ($P<0.05$) for both groups SS and SR. TBA value also showed the same trend of AV. Hence, *Monodora myristica* extract yielded reducing effect in the oxidative level of the oil varieties.

From the study, it is evident that the extract of seeds of *Monodora myristica* has promising antioxidant activity. In the present study, the percentage (%) yield of

the extract was found to be 18.9%, which is relatively low when compared to a previous study on the plant. In a previous study (Esuoso et al., 2000) reported that *Monodora myristica* seed extract had a yield of 34.7-68.8%. The possible difference in the yield could be as a result of geographical and climatic factors, which has been found to affect plant constituents, or time of collection of the seed, method of storage, the variety of the parent plant and the nature of the soil on which it is planted. In the fatty acid content of palm kernel oil and palm oil, stored in the sun, values in the same column, bearing different superscripts differ significantly $P < 0.05$. Hence there was significant increase in oxidation which also reduced as the extract increased.

Monodora myristica seed has been found to contain a lot of secondary plant metabolites namely: alkaloids, carbohydrates, flavonoids, glycosides, proteins, saponins, and tannins. Alkaloids at high concentration, has been found to produce a variety of toxic effects on "animals. They also protect the plant from the effect of singlet oxygen (Bonner and Varner, 1965). These plant constituents are known to be biological active, eliciting a variety of actions such as antioxidant effects. It can also be concluded that the antioxidant activity of the extract could be attributed to flavonoids, which are found in antioxidant plants such as *Aspidium cacutarium* (Ghoghari et al., 2006), *Phyllanthus debilis* Klein ex Willd (Kumaran and Karunakaran, 2006) as well in *Tephrosia purpurea* (Jain et al., 2006).

Changes in Acid Value of PKO and PO

The variation of the percentage of free fatty acid of crude palm kernel oil and palm oil placed in the sun is shown in

Tables 1 - 2. At equal volume of oil, the little decrease in free fatty acid content was observed during the first 3 weeks. Whereas, the group kept in the dark room showed significant decrease in the free fatty acid content. However, at a higher the concentration of extract treatment in each sample, the lower their free fatty acid value. Higher value of percentage free fatty acid content was observed in crude palm oil.

It could be due to the fact that when PKO and PO are exposed to the sun and in the free air, their unsaturated fatty acids fix oxygen and oxidize. The acid value of an oil may be used as a measure of quality. However, the acid value of the oil must not be too high, as this denotes an excessively high content of free fatty acids, which causes the oil to turn sour. Discoloration may also occur. Palm kernel oil should have an acid value of at most 0.1 - 1.0% [1], or 5%. Oils and fats spoil by readily becoming rancid. Rancidity is promoted by light, atmospheric oxygen and moisture and leads to changes in odor and taste.

Changes in Thiobarbituric acid value of PKO and PO

The variation of the thiobarbituric acid number of crude palm kernel oil and palm oil placed in the sun is shown in Table 3 - 4. At equal volume of oil, the significant decrease in content was observed during the first 3 weeks of storage at different environmental conditions. But, the group kept in the dark room showed significant decrease than those kept under the sun. Meanwhile, the higher the concentration of extract treatment in each sample, the lesser the TBA value. Higher value was observed in crude palm oil.

Table.1 Acid value for PKO (MgKOH/g)

Conc. of extract (Ml)	Pre-Storage Day	Week 1 SS	Week 1 SR	Week 2 SS	Week 2 SR	Week 3 SS	Week 3 SR
Control (0.00)	4.75±0.00	5.92±0.36	4.89±0.31	8.24±0.20	5.38±0.08	14.72±10.0	9.70±0.51
0.2	4.70±0.15	5.66±0.28	4.74±0.36	8.06±0.32	5.14±0.13	14.68±0.31	7.74±0.26
0.4	4.45±0.12	5.30±0.28	4.52±0.12	7.86±0.37	5.00±0.31	13.56±0.48	7.22±0.21
0.6	3.92±0.41	4.96±0.31	4.08±0.26	7.32±0.41	4.84±0.26	13.18±0.26	6.26±0.21
0.8	3.44±0.32	4.54±0.29	3.94±0.31	6.92±0.51	4.62±0.31	13.06±0.26	6.18±0.26
1.0	3.06±0.91	4.08±0.34	3.70±0.31	6.40±0.28	4.28±0.31	13.10±0.13	5.99±0.31

SS = Storage in Sun; SR = Storage in Room; AV = Acid Value; TBA = Thiobarbituric Acid

PKO = Palm Kernel Oil; PO = Palm Oil; SD = Standard deviation

Changes in mean ± SD acid value content of Palm kernel oil stored in sun and Palm kernel oil stored in the room

Table.2 Acid value for PO (MgKOH/g)

Conc. of extract (Ml)	Pre-Storage Day	Week 1 SS	Week 1 SR	Week 2 SS	Week 2 SR	Week 3 SS	Week 3 SR
Control (0.00)	14.27±0.26	15.71±0.23	15.42±0.18	17.75±0.13	16.26±0.08	21.02±0.12	18.74±0.36
0.2	14.13±0.11	15.24±1.24	15.21±1.13	17.32±0.52	16.06±0.19	20.83±0.26	18.22±0.34
0.4	13.92±0.26	15.01±0.08	14.73±0.52	16.63±0.08	16.00±1.10	19.92±0.52	16.88±0.26
0.6	13.53±1.02	14.94±0.15	14.71±0.91	16.26±0.15	15.72±0.90	19.61±0.81	16.32±0.31
0.8	13.27±1.31	14.51±0.92	13.81±0.71	15.84±0.12	15.48±1.21	18.91±1.00	16.02±0.81
1.0	13.06±1.42	14.39±1.10	13.36±1.02	14.81±1.10	14.13±1.40	17.26±1.23	15.72±0.92

SS = Storage in Sun; SR = Storage in Room; AV = Acid Value; TBA = Thiobarbituric Acid

PKO = Palm Kernel Oil; PO = Palm Oil; SD = Standard deviation

Changes in mean ± SD acid value content of Palm oil stored in sun and Palm oil stored in the room.

Table.3 Thiobarbituric acid value for PKO

Conc. of extract (Ml)	Pre-Storage Day	Week 1 SS	Week 1 SR	Week 2 SS	Week 2 SR	Week 3 SS	Week 3 SR
Control (0.00)	3.12±0.08	4.14±0.22	4.00±0.26	6.92±0.84	5.50±1.10	9.10±0.81	6.30±0.75
0.2	3.06±0.01	4.09±0.16	3.86±0.29	6.69±1.04	5.32±1.24	8.68±0.50	6.00±0.35
0.4	3.08±0.05	4.12±0.05	3.51±0.33	6.21±1.13	5.01±1.21	8.53±0.13	5.54±0.26
0.6	3.19±0.06	3.81±0.08	3.06±0.36	5.90±1.19	4.78±1.26	8.30±0.26	5.08±0.10
0.8	2.30±0.12	3.15±0.13	2.87±0.13	5.42±0.91	4.43±1.00	7.83±0.26	4.80±0.13
1.0	2.02±0.17	2.72±0.19	2.31±0.21	4.91±0.75	3.90±1.20	7.35±0.26	4.22±0.13

SS = Storage in Sun; SR = Storage in Room; AV = Acid Value; TBA = Thiobarbituric Acid

PKO = Palm Kernel Oil; PO = Palm Oil; SD = Standard deviation

Changes in mean ± SD TBA value content of Palm kernel oil stored in sun and Palm kernel oil stored in the room.

Table.4 Thiobarbituric acid value for PKO

Conc. of extract (Ml)	Pre-Storage Day	Week 1 SS	Week 1 SR	Week 2 SS	Week 2 SR	Week 3 SS	Week 3 SR
Control (0.00)	5.20±0.35	6.57±0.26	5.50±0.21	9.20±0.19	6.61±0.20	10.11±0.17	7.00±0.11
0.2	5.01±0.22	6.29±0.13	5.35±0.29	8.92±0.19	6.36±0.17	9.88±0.15	6.72±0.08
0.4	4.90±0.13	6.01±0.21	5.10±0.31	8.41±0.21	6.10±0.34	9.52±0.11	6.51±0.14
0.6	4.72±0.52	5.74±0.41	4.81±0.26	7.00±0.26	5.90±0.26	9.07±0.13	6.32±0.14
0.8	4.49±0.34	5.42±0.32	4.52±0.26	6.81±0.16	5.71±0.21	8.77±0.25	6.01±0.21
1.0	4.11±0.26	5.10±0.19	4.15±0.21	6.38±0.19	5.20±0.34	8.41±0.27	5.52±0.19

SS = Storage in Sun; SR = Storage in Room; AV = Acid Value; TBA = Thiobarbituric Acid
 PKO = Palm Kernel Oil; PO = Palm Oil; SD = Standard deviation

Changes in mean \pm SD TBA value content of Palm oil stored in sun and Palm oil stored in the room.

This could be due to the fact that when PKO and PO are exposed to the sun and in the free air, their unsaturated fatty acids fix oxygen and oxidize. Most any food can technically become rancid. The term particularly applies to oils. Oils can be particularly susceptible to rancidity because their chemistry which makes them susceptible to oxygen damage. When food scientists talk about rancidity, they are often talking about a specific type of rancidity involving oxygen damage to foods, and this type of rancidity is called "oxidative rancidity." During the process of oxidative rancidity, oxygen molecules interact with the structure of the oil and damage its natural structure in a way that can change its odour, its taste, and its safety for consumption.

Spices contain phenols and essential oils, which are inhibitory to microorganisms (Nakatani, 1999). It was reported that fat and proteins bind or solubilize phenolic compounds thereby reducing their availability for antimicrobial activity.

Effect Of *Monodora myristica* Extract On The Chemical Indices Of Oil On Storage

The main objective of this study was to

evaluate the antioxidant potential of *Monodora myristica*. Two different varieties of oil were treated with *Monodora myristica* extract and tested to determine the antioxidant potentials of *Monodora myristica* using standard methods. The analysis results demonstrated that the extract treatment of the oil samples enhanced antioxidation.

The study results favoured the highest concentration of treatment and storage of the tested oil samples at the different environmental conditions. Recently, the determination of PV in commercial oils was assessed by the modern Infrared Spectroscopy (IR) (Yildiz *et al.*, 2002) which can also be extended to the determination of AV in butter.

Fats and oils are quite unstable substances. When stored for any considerable length of time, especially when the temperature is high and the air has free access to them, they deteriorate and spoil. In this respect different fats differ markedly. Some spoil very much more rapidly than others. Among the various fats, spoilage takes the form of rancidity. The fat acquires a peculiarly disagreeable odour and flavour. A vast amount of scientific research has

been carried on to determine the cause and nature of rancidity, but investigators are far from agreement on the subject. For present purposes it is sufficient to point out that spoilage of a fat, usually identical with rancidity, is accompanied by partial splitting of the fat into glycerin and fatty acids. The glycerin disappears, or at any rate is unobjectionable, but the fatty acids remain dissolved in the fat, give it an acid reaction, and contribute to its objectionable rancid flavor. The rancidity of a given parcel of fat is not necessarily the result of long storage under unfavorable conditions. The fat may have been spoiled and rancid from the moment of its production. This will inevitably be true when the materials from which it was produced have undergone decomposition. Thus the fat obtained from putrefying carcasses will be rancid and so will the oil expressed from fermented cottonseed. In other words, to obtain a sound and sweet fat, the raw material must be sound and sweet; it must be worked up speedily before it has had time to decompose; and this must be done under clean and sanitary conditions. The fat thus obtained must be stored under favorable conditions and its consumption cannot be too long delayed. These conditions it is difficult to obtain in many of the less civilized portions of the world, especially in the tropics, where many fat- and oil-yielding raw materials are produced. Hence fats and oils made at the source of the raw materials may be less sound than those produced at or near the place of consumption.

All oils are fats, but not all fats are oils. They are very similar to each other in their chemical makeup, but what makes one an oil and another a fat is the percentage of hydrogen saturation in the fatty acids of which they are composed. The fats and oils which are available to us for culinary

purposes are actually mixtures of differing fatty acids so for practical purposes we'll say saturated fats are solid at room temperature (20°C) and unsaturated fats we call oils are liquid at room temperature. For dietary and nutrition purposes fats are generally classified as saturated, monosaturated and polyunsaturated, but this is just a further refinement of the amount of saturation of the particular compositions of fatty acids in the fats. Connoisseurs of good edible palm oil know that the increased FFA only adds 'bite' to the oil flavour. At worst, the high FFA content oil has good laxative effects. The free fatty acid content is not a quality issue for those who consume the crude oil directly, although it is for oil refiners, who have a problem with neutralization of high FFA content palm oil.

Oxygen is eight times more soluble in fats than in water and it is the oxidation resulting from this exposure that is the primary cause of rancidity. The more polyunsaturated a fat is, the faster it will go rancid. This may not, at first, be readily apparent because vegetable oils have to become several times more rancid than animal fats before our noses can detect it. An extreme example of rancidity is the linseed oil (flaxseed) that we use as a wood finish and a base for oil paints. In just a matter of hours the oil oxidizes into a solid polymer. This is very desirable for wood and paint, but very undesirable for food.

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