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Physico-Chemical Analysis and Antifungal Activity of *Datura metel* Seed Oil.

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Abstract

The physico-chemical properties and antifungal activity of *Datura metel* seed oil were investigated in this study. The seed oil was extracted by adopting a standard method using soxhlet extractor. Antifungal activity was determined using disc diffusion method. The physicochemical analysis was carried out by adopting standard methods. The physicochemical characteristics showed that the oil is brownish-yellow, liquid at room temperature, it has a percentage yield of (18.20%), Specific gravity was (0.89±0.00), Acid value was (7.60 ± 0.05 mg/g), Iodine value was (12.72 ± 0.04 mg/g), Percentage free fatty acid was (282 ± 0.00%) and Saponification value was (208.98 ± 1.99 mgKOH/g). The result also revealed antifungal activity of *Datura metel* seed oil against the tested organisms *Aspergillus niger, Aspergillus flavus, Aspergillus fumigatus* and *Rhizopus oryzae*. *Aspergillus niger* reveal zone of inhibitions of (2.00±1.00, 2.00±0.50 and 3.00±1.00) at all the concentration of the oil used, *Aspergillus flavus* reveal zone of inhibition of (2.33±0.76 and 3.33±0.76) at 900µl and 1350µl respectively, *Asppergillus fumigatus* reveal zone of inhibition of (2.17±0.58) at 1350µl of the oil and *Rhizopus oryzae* has no zone of inhibition at all the concentrations. The results show that the *Datura metel* seed oil is good for industrial applications and also shows substantial antifungal activity against some tested organism at various concentrations.

Keywords: *Datura metel* seed oil, physicochemical analysis, antifungal activity and zone of inhibition.

INTRODUCTION

Over the years, there has been a spectacular increase in the world demand for both oils and oil meals with attending uptrend in prices [1]. Estimates available on future production indicate that this trend will continue [2]. During the 20th century, the non-edible uses of oil seed products declined substantially due to the availability of relatively inexpensive oil derived from fossil reserves [3]. It is however, now realized that the fossil reserves could be exhausted or become shorter in supply and is not renewable [4]. As such, looking into alternative oil sources from various seeds which abound around us should remain a subject of active investigation. Although such oils is not expected to replace petrochemicals in their entirety [5].

However, in folklore medicinal practices, some oils extracted from plants and plant products/parts such as seed are claim to possess some antimicrobial activities among which is antifungal activity against some pathogenic fungi species. Fungi are the main infectious agents in plants, causing alterations during developmental stages including post-harvest. In fruit and vegetables, there is a wide variety of fungal genera causing quality problems related to aspect, nutritional value, organoleptic characteristics, and limited shelf life [6]. In addition, in some cases fungi are indirectly responsible for allergic or toxic disorders among consumers because of the production of mycotoxins or allergens [6].

MATERIALS AND METHODS

Plant material and preparations

Mature *Datura metel* seed were obtained from Aliero Town in Aliero L.G, Kebbi State, Nigeria. The whole plant was identified and authenticated at the Department of Biological Sciences, Kebbi State University of Science and Technology, Aliero. The Seeds were handpicked to eliminate the damaged ones. The hard shells were cracked and the seeds were manually grounded using mortar and pestle into a powder. The powder sample was stored in a labeled airtight dry container and later used for oil extraction.

Oil extraction

The oil was extracted by soxhlet extraction method as described by [7].

Physico-chemical Analysis

Several physico-chemical properties of oil extracted were determined, which includes: State, Colour, Odour, Specific density, state, saponification value, iodine value, acid value, Percentage free fatty acid and percentage yield.

Colours, Odour, State (at room temperature) were determined according to the method as described by [8]. Percentage yield, Specific density and Saponification value were also determined according to the method as described by [8]. Iodine value was determined by using the method as described by [9]. Acid value was determined by the method as described by [10]. Similarly, the free fatty acid was determined by adopting a method as described by [11].

Anti-Fungal Assay

The antifungal activity of the *Datura metel* seed oil against *Aspergillus niger, Aspergillus flavus, Aspergillus fumigatus and Rhizopus oryzae* were determined using the disc diffusion method as described by [12]. Briefly, seeded agar plates were prepared by pouring 30 ml of Sabouraud Dextrose Agar (SDA) into each sterile plate. After solidification of the medium, each plate was inoculated with the suspensions of *Aspergillus* and *Rhizopus*. *Datura metel* seed oil were applied on filter paper disks (450, 900 and 1350 µl/10 disks) of 6 mm diameter. Ketoconazole was used as positive control. The discs were placed on the surface of agar plates, all the plates were incubated. The inhibition zone was determined by measuring the diameter of the clear zone around each disc.

RESULTS AND DISCUSSION

Table 3.1: Physical properties of *Datura metel* seed oil

PARAMETERS	RESULTS
Oil yield (%)	18.20%
Colour	Brownish yellow
Odour	Agreeable
State (at room temperature)	Liquid
Specific gravity (g/cm^3)	0.89±0.00

Table 3.2: Chemical properties of *Datura metel* seed oil

PARAMETERS	RESULTS (Mean ± S.D)
Acid value (mg/KOH/g)	7.60 ± 0.05
Iodine value (mg/Iodine/100g)	12.72 ± 0.04
Saponification value (mg/KOH/g)	208.98 ± 1.99
Percentage free fatty acid (%) (mg/g)	282 ± 0.00

Values are presented as mean ± Standard deviation of 3 replicates.

TABLE 3.3: Antifungal activity of *D.metel* seed oil against *Rhizopus oryzae, Aspergillus niger, Aspergillus flavus, Aspergillus fumigatus* and ketoconazole.

Diameter of Inhibition Zone (mm)				
Test Organisms	**Concentrations**			
	450µl	**900µl**	**1350µl**	**Ketoconazole (500mg)**
Aspergillus niger	2.00±1.00	2.00±0.50	3.00±0.87	5.00±1.00
Aspergillus flavus	_	2.33±0.76	3.33±0.76	5.00±1.00
Aspergillus fumigatus	_	_	2.17±0.58	5.00±1.00
Rhizopus oryzae	_	_	_	4.33±1.53

KEY: –: No Zone of inhibition.
Values are presented as mean ± Standard deviation of 3 replicates.

Physicochemical properties of the oil

From the present study, the physical properties of the oil; the colour was free from sediments, brownish yellow, odour and state at room temperature were standard like other conventional edible and commercial used oils. As such the oil may be used for commercial purposes.

The specific gravity value obtained in this research is higher than that of egusi seed oil (0.874) reported by [13], lower than (0.962) for cashew nut oil, (0.954) for *Desert melon* seed oil [13], according to [14] oil with low specific gravity is an indication that it contain low molecular weight fatty acid, likewise it will have high saponification value which makes it suitable for industrial uses. Specific gravity is the comparison of the weight of the oil to that of water having the same volume and at a given temperature of 25℃. Specific gravity measurement can be used in a wide variety of industries. It is particularly useful because it allows access to molecular information in a non-invasive way [15]. Studies have shown that the specific gravity of different refined oils varies with their molecular weights which are affected by refining processes [16]. The result of the specific gravity is (0.89) which is less than that of water (0.99) at the same temperature of 25℃.

The acid value obtained is lower than that of olive oil 17mgKOH/g [17] and that of shea oil 14·77± 0·065 reported by [18] and higher than the following seed oils; *Hyptis spicigera* seed oil 2.5mgKOH/g [17], *Citrus lanatus* seed oil 5.25mgKOH/g [19], *Avocado pear* seed oil 5.200mgKOH/g [20] which made it suitable for industrial applications. Acid value is an indicator for edibility of oil and suitability for industrial use [21]. *Datura metel* seed oil could be used for commercial purposes, since the value falls within the recommended codex of 0.6 and 10 for virgin and non -virgin edible oils and fats nearest to other conventional oils, which are already in use for edible and commercial industries [22]. Acid value determination is often used as a general indication of the condition and edibility of the oil. This is because an increase in acid value is accompanied by development of objectionable flavours odours [21].

The iodine value obtained is less than 100, which shows that the oil could be classified as non-drying oil. Non-drying oils have iodine values less than 100 which are useful in the production of soaps [23]. It is an indicator for double bindings in the molecular structure, which influences the long term stability properties of the oil (i.e. important for storage) [24]. Oils having high iodine number are polyunsaturated indicating the degree of unsaturation and are desired by oil processors, while a lower iodine number is indicative of lower quality [24].The result show low iodine value of 12.72mg/g indicating that the fatty acid presence is unsaturated, especially oleic oil. *Datura metel* seed oil lies in the category of non-drying oils (non-drying oil is an oil which does not harden when it is exposed to air). The non-drying oils have a wide variety of industrial uses; they enter into soaps and cleansers, cosmetics, lubricants, leather dressings, and candles. They are used in the processes of wool manufacture, especially carding; they are employed in making tin plate and in foundry work [24].

Saponification value obtained is lower than 213mgKOH/g in neem seed oil [25] and 253.2mgKOH/g in coconut oil [26], higher than that of *Dennettia tripatala* fruit oil (Pepper fruit) 159.33±1-20 [27] and African pear oil 143.76 mgKOH/g which could be good for industrial uses [20]. Saponification value is an indication of the size or nature of fatty acid chains esterified to glycerol. In combination with acid values, saponification values are useful in providing information as to the quantity, type of glycerides and mean weight of the acids in a given sample of oil [28]. Saponification is only of interest if the oil is for industrial purposes, as it has no nutritional significance. But due to the fact that each fat has within the limits of biological variation, a constant fatty acid composition, determination of the saponification value is a reasonable means of characterizing the fat [28]. The result shows high saponification value of 208.98mgKOH/g indicating that the oil can be used industrially for making soap.

Free fatty acid is the percentage by weight of a specified fatty acid (e.g. percent oleic acid) [29]. High concentrations of free fatty acids are undesirable in crude vegetable oils because they result in large losses of the neutral oil during refining. In crude fat, free fatty acids estimate the amount of oil that will be lost during refining steps designed to remove fatty acids [30]. High levels of free fatty acids especially linoleic acids are undesirable in finished oils because they can cause off -favours and shorten the shelf life of oils [30]. The quantity of free fatty acid in oil is an indicator of its overall quality. They may be formed through hydrolysis or in the advanced stages of oxidation. An excessive amount of free fatty acids lowers the smoke point of oil and will cause 'popping' of the oil during cooking. High quality oils are low in free fatty acids [31]. In refined vegetable oils, the lower the free fatty acid the more acceptable the oil is to man in terms of palatability. From the result, the percentage free fatty acid of oil obtained is high indicating that the oil is not good for consumption.

Antifungal activity of the oil

The result of the antifungal activity of *Datura metel* seed oil reveals that *A. niger* has zone of inhibition at all concentration of the oil, which indicates that the oil can be used as antifungal agent. While *A. flavus* has only zone of inhibition at 900µl and 1350µl of the oil which show the oil can be use as antifungal agent but at high concentrations, *A. fumigatus* has zone of inhibition at 1350µl of the oil which also shows that the oil can be use as antifungal agent but at high concentration. In the case of *Rhizopus oryzae* there is no zone of inhibition at all the concentrations of the oil which means either the oil has no activity against *R. oryzae* at all or the concentration used is too low to inhibit the organism. However, the inability of the oil to inhibit the growth of the tested organisms at lower concentrations may be due to the low levels of the active ingredient (the bioactive compounds) in the concentration of the oil [32]. The inhibitory effect of the plant oil at the various concentrations against the tested organisms has established antifungal potentials of the seed.

CONCLUSION

From the physico-chemical analysis results of the oil obtained in this study, it can be concluded that *Datura metel* seed oil can be used in industries for soap making, cosmetic, lubricants, leather dressings and candles industries, because many of the physico-chemical properties of *Datura metel* seed oil studied are similar with other conventionally used oils. Physico-chemical properties of oil, shows that *Datura metel* seed oil can be used in commercial scale in many industries. The results of the antifungal activity indicate that the oil of *Datura metel* seeds has an interesting antifungal activity. According to the results, extracted oil from *Datura metel* seed may be used an alternative to the synthetic antifungal agents.

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