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Biochemical analysis of oil quality from orange seeds (*Citrus sinensis*)

Yusuf H[1], Bello KS[2], Ebu B[3], Ijebor FD[4]
[1-4] Department of Science Laboratory Technology, Federal Polytechnic, Bauchi, Nigeria

Abstract
Citrus sinensis seeds obtained from discards of fruits was washed and prepared for use by decocting, sun drying and grinding. Oil from 50g of *Citrus sinensis* seeds was extracted by soxhlet extraction method using Diethyl ether as a solvent. The extract was centrifuged to remove particulates. On dry matter basis, the oil yield was found to be 38.45%. The physical evaluations of the oil were based on Texture, Colour, Odour, Moisture, Refractive index and Relative density, whereas chemical evaluation was based on Ash content, Organic matter, Iodine value [IV], Saponification value [SV] and Peroxide value. The experimental results show that oil has golden yellowish colour liquid with pleasant Odour, relative density of 0.8911g/cm^3, moisture content of 6.0%, refractive index of 1.467 at 25°C, ash content of 8.0%, organic matter 89.0%, iodine value of 126.24mg/g, Saponification value of 185.38mgKOH/g and peroxide va1ue of 4.89MEq/Kg. The *Citrus sinensis* seeds oil was classified as a non-drying oil and this non-drying attributes qualifies it for use in applications where oxidation is undesirable e.g. can be used for the production of Soap, Perfumes, candles, flavoring, lubricant in chemical industries, leather dressing industries and in the production of insecticides.

Keywords: *Citrus sinensis*, extraction, oil, quality, non-drying oil

Introduction
Citrus sinensis is of the family Rutaceae and sub-family Aurantiodeae [5]. The sweet orange is a hybrid of ancient cultivated origin, possibly between pomelo (Citrus maxima and tangerine Citrus reticulate). Sweet orange tree is a medium size plant often grown to a height of 6.0m – l00m. The broad, glossy, ever green leaves are medium sized and ovate with crenulated margins and about 4 - 12cm in diameter; the petioles (leaf stalks) have narrow rings. The peel is 0.5cm thick and tightly adheres to the segments. Upon ripening, it changes into an oranges colour but often remains green or pale yellow in tropics. The pulp is very juicy and slightly acidic [6]. The central line is solid and it may contain no seeds or many seeds. Sweet orange seeds occur with the berry and are embedded in juice sacs of the loculus and very close to the central axis [8, 10, 1].
The Oil quality parameters of the oil extract from *Citrus sinensis* consequently gives a qualitative identification of oil, and is a very important area in the commercialization and utility of oil product [19]. Therefore, there is a need to determine its edibility and potentials in industries compared to other locally available oil and to determine, if the oil can compete with other vegetable oils like ground nut, Soya beans etc. To also, find out if the oil can serve as a source of cheap vegetable oil for the growing population of this country.

Material and Method
Chemicals
All chemicals used were of analytical grade and were products of Riedel-de Haen, chemical Ltd., Germany.

Collection and preparation of seeds sample
The *Citrus sinensis* seeds were obtained from discards of fruits from Bauchi main market, Bauchi state, Nigeria. *Citrus sinensis* seeds were collected, washed and then prepared for use by decocting, sun drying and grinding into fine powdery form to create a large surface area for proper extraction of the oil.

Oil Extraction
50g of *Citrus sinensis* seeds was extracted by continuous extraction in Soxhlet extractor for 8hrs, using Diethyl ether (60-80%) as a solvent, according to method 28.002 described by [2]. At the end of the extraction, the residual solvent was evaporated in Gallenkamp forced air oven at 105ºC to constant weight. The extracted oil was stored in air tight and moisture proof containers at room temperature, for further analysis.

Oil quality Parameters
The oil quality parameters were carried out according to the methods described by [2].
Iodine value (IV) was determined according to methods 28.023 and 28.024, Peroxide value (PV) according to methods 28.025 and 28.026, Saponification value (SV) according to methods 28.28 and 28.029. Relative density was determined according to [7], while Ash content and refractive index was according to methods reported by [16]. and [12]. respectively.

Results and Discussions
The value of the product yield makes the industrial practice of the oil recovery a profitable venture, and will reduce the level of waste that is obtained from the juice making industry, further more; the positive economic implication stated that other deductions can be made by careful look at the availability of the *Citrus sinensis* fruit. [Table 1] revealed the percentage oil yields of 38.45%. This value makes the *Citrus sinensis* seeds economically viable when compared with other known oilseeds like G. nut oil 46.5% and Cotton seed 16-17%, [13 and 17]. The oil content of

Citrus sinensis seeds varies depending on the agro-ecological origin and it was shown that the fruits, even when damaged, seeds can be used in small scale oil production. However, oil yield varies due to climatic condition. However, the result 38.45% can be compared favourably with the known standard of some edible oils such as groundnut oil, sesame oil etc. [4]. Hence, the attention of farmers is drawn on its importance for small scale oil production [11]. Moisture content influence the pattern of spoilage and this involved the measurement of weight lost due to evaporation of water to a constant weight of the sample. The standard value for most foods, moisture content varies between 8-16%, [18]. As shown in [Table 2], moisture content of the *Citrus sinensis* seeds recorded 6.0% and hence, within the standard value stated. Colouring matter in the oil are the soluble pigments which are among the natural components of fats and oils that occur in minor quantity. The golden yellowish colour of *Citrus sinensis* seed oil extract as shown in [Table 2], indicates the presence of carotenoids in the oil. Carotenoids are yellow to deep red colour materials that occur naturally in fats and oils [3]. They consist mainly of carotenes such as lycopene and xanthophylls such as lutein. Palm oil contains the highest concentration of carotene. Hence, most vegetable oil contains a number of impurities like moisture, free fatty acids, colouring matter, resin gums and vitamins which affect the flavor, odour, clarity and are removed during refining. The relative density was found to be 0.8911g/cm^3. The refractive index was found to be 1.467 at 25°C which falls within the range of recommended values of 1.445-1.470 refractive index for edible vegetable oil [9].

The chemical characteristics are presented in [Table 3]. The saponification value of the oil was 185.38mgKOH/g. The significance of SV is used primarily as indication aid as adulteration with unsaponifiable matter is easily seen, and it can be used to measure the mean molecular weight of the fatty acids present in the oil. Values of 200mgKOH/g and above are indicative of fatty acids of low molecular weight. Fatty acids of low molecular weight require the most alkali; therefore, SV is inversely proportional to the mean of molecular weight of fatty acids present in triglycerides. Low SV < 80mgKOH/g indicates the presence of long chain fatty acids molecule or high molecular weight molecule[3]. However, SV of 185.38mgKOH/g for *Citrus sinensis* seeds oil is comparable to most edible oils are within the range, Ground nut oil (188 - 196mgKOH/g), Corn oil (187 - 196mgKOH/g), Palm oil (196 - 205mgKOH), Milk fat (210 - 233mgKOH), and Coconut oil (250 - 264mgKOH/g). The low SV suggest that, it may be industrially useful, and the relatively high value increase recorded, is indicative that it may have potential for use in other industries [20]. The Iodine value of 126.24mg/g may be classified as non-drying oil. This nondrying attributes qualifies them for use in applications where oxidation is undesirable e.g. lubricating, food, soap, and leather dressing industries. Oil having low or no unsaturation are very resistant to rancidity and have definite odour and flavour. The IV obtained in this study indicates that the oil did not contain appreciable level of unsaturated bonds. In general, the greater the degree of unsaturation the higher the IV and, also the greater the liability of the oil or fat to become rancid by oxidation [15]. Peroxide value is used as an indicator of oxidative deterioration of oils. Fresh oils have values < 10meq/kg. Oils containing polyunsaturated fatty acids easily undergo oxidation, resulting in rancid odour and bad taste. A rancid odour often begins to be noticeable when PV is between 20-40meq/kg and PV obtained from this study was 4.89meq/kg [Table 3].

Table 1: Oil Yield of *Citrus sinensis* seeds

Sample	Mass (g)	Oil yield (%)
Citrus sinensis seeds	50.0	38.45

Table 2: Biological/Physical Characteristics

Analysis	Results
Moisture Content	6.0%
Colour	Golden yellowish
Odour	Pleasant
Refractive index	1.557
Relative density	0.8911g/cm^3

Table 3: Chemical Characteristics

Analysis	Results
Ash Content	8.0%
Organic Matter	89.0%
Saponification value	185.38mgKOH/g
Iodine value	126.24mg/g
Peroxide value	4.89mEq/Kg

Conclusion

It can be concluded that, industrial extraction and commercialization of the seed oil from *Citrus sinensis* fruit can be intensified in the industries for the production of soaps, perfume candles, flavoring, and lubricant in chemical industries, leather dressing industries and in the production of insecticides.

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