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Experimental Based Analysis of Minor Bioactive Compound Composition of Avocado, Mango and Native Pear Seed oil for Pharmaceutical Utilization

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Abstract

Oil was extracted from avocado, mango and native pear seed through the mechanism of mechano-thermal techniques. In this process no solvent was added for the purpose of the oil recovered rather the mechanism of extraction was mainly mechanical and distillation process. The different oils recovered from the process were subjected to pharmaceutical analysis to ascertain the properties of some minor bioactive compounds and their compositions in relation to the three samples of the agro-based seeds examined. The parameters analgised were total tocopherols, β – tocopherol, α – tocopherol, γ – tocopherol, total carotenoids, β - cryptoxanthin, β - carotene, total phenolics[a] and total flavonoids[b]. The results of the oil recovered from the agro-based seeds illustrates the following characteristic of biological properties in terms of the bioactive compound value of total tocopherol value pof 51.27, 67,28 and 70.20 for mango, avocado and native pear seeds and for α – tocopherol value of 42.32, 54.30, and 60.14, β – tocopherol value of 1.89, 2.24 and 2.79, γ – tocopherol value of 2.06, 2.92, and 2.86, total carotenoids value of 8.81, 9.70, and 9.95, β – cryptoxanthin value of 8.50, t.61, and 7.96, β – carotene value of 4.85, 7.18, and 7.94, total phenolics[a] value of 610.70, 803.30, and 5053.11, total flavonoids[b] value of 1.55, 1.89, and 2.76 of mango, avocado and native pear seeds respectively. This research has revealed that the native pear seed is more medicinal for pharmaceutical benefit when used compared to avocado and mango seed as demonstrated by the properties of the minor bioactive compound of the 3 varieties of the agro-based materials sampled. The research also, compared the cost implication of solvent extraction and mechano-thermal approach of oil recovered from these seeds and conclude that the mechano-thermal techniques is the better than the solvent method.

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INTRODUCTION

In the Anacardiaceae family, which also contains pistachios, cashews, and poison ivy, you may find the mango. Worldwide, it goes by a variety of names, including manga, odel, mangot, mangou, and mangue [19]. A mango's colour may vary from greenish to reddish, with hints of pink, orange-yellow, or red, and there are more than fifty different types to choose from [1115]. It is thought that in the fourth and fifth centuries BC, Buddhist monks brought mangoes on their travels to Malaya and eastern Asia [1620]. Legend has it that the Lord Buddha himself discovered odelling, or rest, in a mango orchard after meditating beneath a mango tree, which is why the fruit is revered as holy in this area. Fa-Hien and Sung-Yun state that around 500 BC, Amradarika gave the Lord Buddha an orchard of mango trees to meditate in [2125]. Around 400–500 years ago, nomadic Buddhist monks were the first to divulge the secret and start trading mangoes. The Stupa of Bharut, which is believed to have been built about 100 BC, has friezes depicting a mango tree [26-33]. Across an orchard in the Indus Valley, Alexandra the Great's armies had advanced. Many of the South-east Asian region believe that the better kinds of mango were brought to the region by Indian merchants and monks [3439] Two ancient odelling travelogues, by Hüan Tsang (632-645 AD) and Ibn Haukul (902-968 AD), both mention mangoes [4042]. The other is Ibn Batuta (1325-1345 AD) [43]. The mango was introduced to China by the Chinese odelling Hüan Tsang on his voyage to India (632 - 645 AD) [44]. In his Herbarium, the German-born botanist Georg Eberhard Rumphius states that the mango was only recently brought to some Indonesian islands. However, it was cultivated in Java as early as 900-1100 AD, when the Borobudur temple had carvings of the Lord Buddha sitting under a mango tree in contemplation [45-50]. There can be no question that mangoes originated in the southern regions of Asia [51]. The scientific roots of the domesticated plants have been the subject of several study [52]. Fig 1

Fig 1: Mango-first Inflorescence [53].

Over time, the mango spread from its original home in the Indo-Burman (Myanmar) area to every country that grows it [53]. Around 300–400 AD, mango seeds began making their way from Asia to the Orient, East Africa, and finally South America. Its first destinations were Southeast Asia and the Malay Archipelago; by the seventh century, it had made its way to China [54-55]. It is believed that it was transported to East Africa by the Persians sometime in the 10th century AD. The Muslim missionaries who arrived in the Philippines at the start of the 15th century brought mango trees to the islands of Sulu and Mindanao [56-59]. The mango first arrived in the Philippines from India in the late fifteenth and early sixteenth centuries, brought there by the Spanish. Portuguese and Spanish explorations beginning at the tail end of the fifteenth century brought mangoes from South and Southeast Asia to tropical and subtropical regions around the globe [60]. Portuguese sailors transported mangoes to Brazil in the 1700s after first bringing them to Africa in the 16th century [61]. At the turn of the 18th century, the Portuguese transported mangoes from Goa to South Africa and vice versa]62]. Although it was already widely cultivated in the East Indies prior to the first Portuguese trips, the Portuguese did import it to the West Indies from Africa. It was in 1782 that the mango was transported from Bourbon to Santo Domingo of Barbados in the West Indies, and it was transported to that location in the middle of the 18th century [6365].

Portuguese merchants brought mangoes to Barbados from Rio de Janeiro around 1742. The product made its way to Mexico from the West Indies and the Philippines at the turn of the nineteenth century. Mangoes first arrived in Jamaica in 1782 from Barbados and in 1809 from Mexico to Hawaii. It then started appearing in random places around the globe. Source [6668]. Fig 2

Fig 2: Mango- Large Tree [69].

Some believe that the first attempt to clone better monoembryonic trees occurred in India when the Portuguese, who had commercial outposts along the west coast of the country in the 15th century, brought vegetative propagation techniques with them. Several hundred years of vegetative propagation have allowed the most significant mango cultivars of India, such as Alphonso, Dashehari, Langra, etc., to continue their lineage from choices made during Akbar's reign (1542-1605 AD) [70]. Fig 3 and 4

Given that a common name of Spanish origin was used fifteen years earlier in the Book of the Continuation of Foreign Passages, and that Sir Hans Sloane reported several instances twenty-four years later, it is puzzling that Hughes did not hear "it called by any other name than the Spanish Pear, or by some the Shell Pear [72].

It is to Sloane, indeed, that we must look for the first record of the name now generally accepted, avocado. This distinguished naturalist published in 1696 a catalogue of the plants of Jamaica, among which he listed, but did not describe, this tree. He referred to many previous accounts, and made the observation in Latin: "The Avocado or Alligator Pear-Tree. It grows in gardens and fields throughout Jamaica." Some thirty years later, in 1725, he published an extensive work entitled, "A Voyage to the Islands of Madera, Barbados, Nieves, St. Christophers, and Jamaica," in which was included a natural history of the last-named island. One chapter was devoted to "The Albecato Pear-Tree; Spanish, Abacado, or Avocado [72-73] Fig 5

Fig 3: Mango- fruited Trees in Orchard [71].

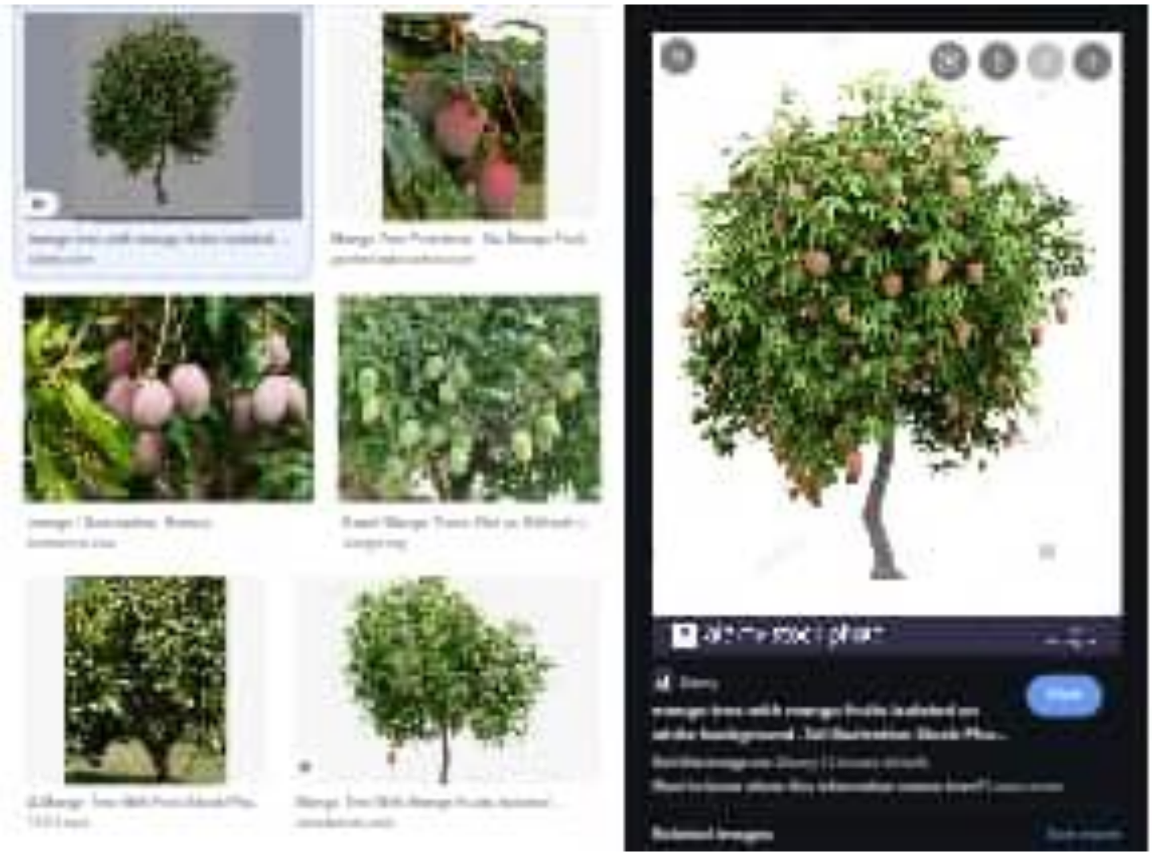

Fig 4: Showing Mango Tree with Fruit [71]

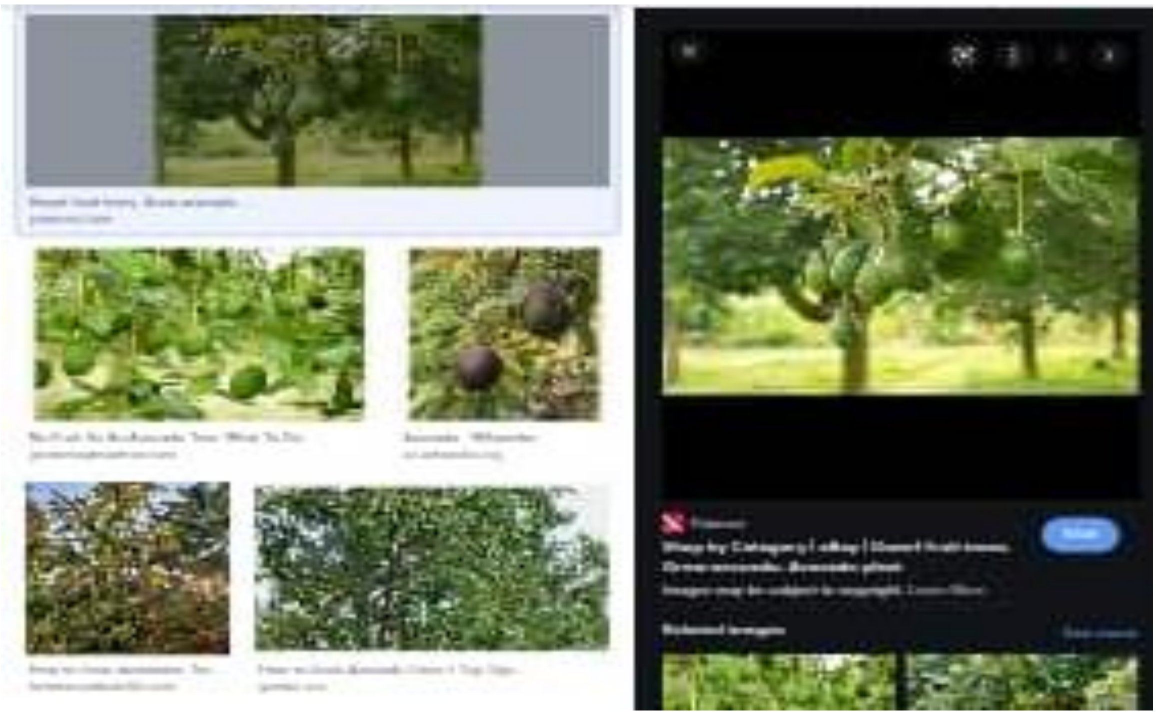

Fig 5: Showing Picture of Avocado Pear Tree [73].

Pears were a prevalent motif in Flemish floral and fruit artworks throughout the 15th to 17th centuries. During the 19th century, the Impressionists sometimes included pears in their paintings, but apples were more regularly shown [74-76]. Vincent Van Gogh included both a blossoming tree and fruit in his paintings, while Paul Cézanne often incorporated pears into his many still life compositions. The renowned artist Fernando Botero, a prominent figure of the 20th century, skilfully incorporates pears in his artwork, whether it paintings or sculptures, to highlight the corpulent but elegant shapes of both human figures and fruits. The publication was authored [77-81]. Fig 6

Fig 6: Showing Native Pear Tree [54]

MATERIALS AND METHODS

Materials and Method for HPLC/MS GAS Chromatograph

Sample Preparation

Petroleum ether was used in the Soxhlet extraction of the sample. For every Soxhlet extraction, which was carried out at 80 °C for 8 hours, around 5 g of dried material and 80 Ml of petroleum ether (60-90 °C) were used. Following the extraction process, the solvents were removed using a vacuum, and the samples were then kept at 4 °C for future reference.

Procedure

The matching FAMEs were synthesised from lipids that were obtained following sample extraction. Using 10 ml centrifuge tubes, 40 ml of the was mixed with 0.7 ml of a potassium hydroxide (10 M) solution and 5.3 ml of methanol. Using a mixer set to 5 s pulses every 20 minutes, the reaction was carried out at 55 °C for 1.5 hours. The reaction was maintained at 55 °C for 1.5 hours, with 5 seconds of mixing every 20 minutes, after the mixture had cooled to room temperature. 0.58 millilitres of odelling acid (10 M) solution were then added. Once the mixture had cooled to room temperature, 3 millilitres of n-hexane were added and stirred for 5 minutes. The tubes were then spun in a centrifuge for 5 minutes to separate the extracts, which were then sent to GC for further examination.

The GC-MS analysis was performed using a 60 m×0.25 mm, i.d. 0.25 µm/MS DB-WAX capillary column (Agilent) and an Agilent 6890 gas chromatograph with a 5973 MS detector. Injector at 250 °C, oven at 200 °C (kept for 1 minute), and then oven heated to 230 °C (1.5 °C min-1, maintained for 10 minutes) was the temperature ramp employed. The SCAN mode was used to characterise and identify the FAMEs in the sample, using a m/z range of 35 to 450. The nitrogen was injected manually at a rate of 1 ml min-1 with a volume of 1 νl. The injection port of an Agilent 6820 gas chromatograph was used to assess the fatty acid composition of the FAMEs extracted from the sample. The column used was a Supelco capillary column (hp-innowax, Agilent, 100 m×0.25 mm, i.d. 0.20 µm). The oven was preheated to 200 °C and kept there for 1 minute. Then, it was raised to 230 °C and kept there for 1 more minute, this time at a rate of 1.5 °C min-1. Both the injector and the detector were adjusted at 250 °C and 280 °C, respectively. The carrier gas, nitrogen, was introduced at a rate of 1 Ml min 1. A 1 νl sample was used, and the split ratio was 50:1.

Materials and Method for G.C/MS

Sample Preparation

A 10-gram portion is spiked with the odellin compounds, while a 20-gram portion is homogenised. Following a minimum of 30 minutes of drying time in anhydrous sodium odellin, the sample is extracted with methylene chloride in a Soxhlet apparatus for 18 to 24 hours. We measure the lipid content after drying the extract using an evaporator.

Procedure

For phytochemical analysis, the extracts were cleaned with a sequential methylene chloride-n-hexan (1:1) mixture. Then, a gas chromatograph was used, which could have a narrow- or wide-bore fused-silica capillary column, an electron capture detector (GC/ECD), or an electrolytic conductivity detector (GC/ELCD). 1 millilitre of the sample was injected into the apparatus.

Results And Discussion

The research has shown the trend of the bioactive characteristics of the minor compound composition as well as the cost implication to obtain the oil from native pear seeds. The obtained results from the study hare demonstrated in Tables 1, 2 and 3 below.

Table 1: Minor Bioactive Compounds Compositions of Avocado, Mango and Native Pear Seed oil (mg/kg) for Pharmaceutical Industry

S/No	Compounds	Manago	Avocado	Native Pear
1	Total tocopherols	51.27	67.28	70.20

2	$\propto -tocopherol$	42.32	54.30	60.14
3	$\beta - tocopherol$	1.89	2.24	3.79
4	$\gamma - tocopherol$	2.06	2.92	2.86
5	Total carotenoids	8.81	9.70	9.95
6	$\beta - cryptoxanthin$	6.50	7.61	7.06
7	$\beta - carotene$	4.85	7.18	7.94
8	Total phenolics[a]	610.70	803.30	5053.11
9	Total flavonoids[b]	1.55	1.89	2.76

Table 1 showcase the properties of some minor bioactive compound composition of mango seed, avocado seed and native pear seed. The investigation was able to demonstrates the usefulness of each material sampled in terms comparison of the bioactive property and the data obtained have shown that native pear seed values are more acceptable than mango seed and avocado seed oil produced from the process. However, each of the oil obtained were rated good but in comparison the native pear yield is higher than the other 2 species tested.

Table 2: Cost of Production for Solvent Extraction Process (Native Pear Seed Oil Roside Specie)

Weight of Materials For Extraction (g)	Quantity Solvent (ml)	Volume Recovered (ml)	Cost (N)
150	300	15	1,300.00
200	400	18	2,200.00
250	500	25	2,800.00
300	550	31	3,100.00
350	600	37	3,300.00
400	650	42	3.700.00
Total	2.7 liters	168	16,400.00

Table 2 shows rough cost estimate of using solvent extraction method of producing the oil from each of this native pear seed by considering various weight of the raw material, the quantity of the solvent required to achieve each process, the possible volume of oil to be extracted as well as the cost implication was demonstrated in Table 2 and the it is observed that as the weight of raw material charged into the process plant increases the amount of solvent for extraction increases as well. Therefore, the cost of production increases as well as observed in Table 2.

Table 3: Cost of Production for Methano-thermal Extraction Process (Native Pear Seed Oil Roside Specie)

Weight of Materials for Extraction (g)	Quantity Solvent (ml)	Volume Recovered (ml)	Cost (N)
150	NIL	24	NIL
200	NIL	38	NIL
250	NIL	43	NIL
300	NIL	64	NIL
350	NIL	58	NIL
400	NIL	69	NIL
Total	NIL	306	NIL

Table 3 shows the concept of mechano-thermal application of oil recovery from the three varieties of agro-based materials namely, mango seed, avocado seed and native pear seed. The process involved in the recovering of the oil does not include the used of solvent rather the application of mechanical and distillation is considered. Indeed, the cost is almost free, the cost of electricity, transportation, logistics, procurement, and manpower was not considered in the research. In comparison of Table2 and Table 3 it is observed that the mechano-thermal approach of processing the mango seed, avocado seed and native pear seed for the production of oil is the mechano-thermal rather than solvent extraction as well as cost wise involvement.

CONCLUSION

Examination of the three types of oil, as well as its physical and chemical properties, agro seeds (Mango, Avocado and Native Pear Seeds) showed that oil has valuable components that contain raw materials for chemical, pharmaceutical and food industries. The quality of these oil and the properties found is commensurate to other raw materials that can be used effectively in the 3 industries as raw materials.

This research also involves assessment of the oil's physical characteristics, including density, viscosity, and refractive index, derived from nine different types of sunflower seeds. Additionally, the oil's chemical characteristics, including its iodine value, peroxide value, acid value, saponification, and free fatty acid levels. When employed as a quality standard, these oil physiochemical properties provide a valuable reference point in chemical and food processing industries. It was also observed from the elements dictated in the HPLC/ MS GC analysis of the oil from the 9 species that the oil contains quercetin flavoncid for mango seeds (Enugu 15.28% Benue 21.50 Opiro 20.50% menoterpences (Enugu 2.70%, Benue 1.29% Opioro 3.66%. sesquiterprenes for Enugu 20.10, Benue 19,74 Opioro 15.98.

For Avocado Pear Seed quercetin flavonoid (Hass 22.17% Bacon 22.01% Reed 22.14.14%. Monoterprenes (Hass 3.70%, Bacon 3.01%. Reed 4.11% for sesquiterpene (Has 16.23% Bacon 17.21% Reed 17.16%. for Native Pear Seeds quercetin flavonoid (Saphindules 13.90% Eludicot 24.10% Rosides 18.24, Monoterprenes (Saphindales 3.80%, Eludicot 4.41%. Rosides 4.20 sesquiterpene (saphindales 19.92 Eludicot 24.18 Rosides 22.60. other substances dictate by the HPLC/ MSGC in the oil which constitute vital raw materials in the oil in pharmaceutical industry for drug productions. Analysis of the oil's physical and chemical properties revealed that the oil's created from the 9 species of agro seeds met the standard specifications of useful and quality oil which could serve as raw materials in chemical, pharmaceutical and food processing industry. Extracion of oil was also carried out on the same 3 difference agro seeds and their various species using solvent (hexane). It was observed that more yield of oil was obtained using Mechano-thermal extraction/distillation method compared to that of solvent soxhlet extraction method

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