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COMPARATIVE STUDY OF POLYSTYRENE MODIFIED WITH *Sand apricot* (SA) SEED OIL and *Uvaria chamae* (UC) SEED OIL

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ABSTRACT

In order to improve the utilization of polystyrene in the area of packaging, consumer electronics, building, medical, and food service disposables, it is necessary to modify some important properties. This paper focused on the comparative study of polystyrene modified with Sand apricot (SA) seed oil and Uvaria chamae(UC) seed oil. Oil from the two seed was isolated, the quality parameter determined and the comparative analysis on some mechanical properties of polystyrene blended with Sand apricot and Uvaria chamae seed oil determined.The findings on the quality of the SA and UC seed oil are as follows: oil content (10.39% and14.56%), specific gravity at 25 oC (0.931 ± 0.21 and 0.87 ± 0.10), acid value (11.083 ± 0.18mg KOH and 9.028 ± 0.32 mg KOH), iodine value (20.798± 0.40 and 10.807 ± 0.40), peroxide value (12.30 and 7.2), free fatty acid (6.30% and 4.015%), and saponification values (283.271 and 173.392). The mechanical properties of the polystyrene blend with SA and UC seed oil (PS-SA and PS-UC) at 100g were reported as follows; ultimate tensile strength (58.6 and 50.4MPa), Young modulus (1954.0 and 1986.4MPa), % elongation (13.4 and 12.3%), break load (500.6 and 300.6 N), and Shore D hardness (80.0 and 79.0), The findings revealed that the mechanical properties of PS-SA and PS-UC were highly competitive with the conventional white petroleum oil used as a plasticizer. As a recommendation, Sand apricot and Uvaria chamae seed oil should be used as a plasticizer since it is available, cheap, and environmentally friendly.

Keywords: Polystyrene, seed oil, blend, mechanical properties, modification

INTRODUCTION

A substantial number of polymer applications are the result of their initial properties and how they are processed. It is usual practice in the polymer sector to undergo synthesis modifications to enhance certain qualities and expand these applications [1]. Polystyrene has shown to be resistant to biodegradation and can be made either hard or flexible with the help of plasticisers; it is widely considered the most long-lasting thermoplastic polymer. Not only that, it has insulating, optical, and chemical qualities while being relatively light [2, 3]. It is utilized in a variety of applications, including synthetic rubbers, styrene alkyd coatings, latex paints, and

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plastics. In addition to its usage in electronics, construction materials, food-contact packaging polymers, and the manufacturing of various toys, cups, and office supplies, it has numerous more applications [4]. The usage of plastics in packaging has grown substantially in the last 20 years. The many uses of plastics stem from their many positive qualities, including their low cost, ease of use, durability, and good looks. A wide range of products can be formed from polystyrene, such as disposable cups, CDs, water pumps for showers, and plastic packaging [1, 5]. A renewable resource, plant oils and vegetables provide a solid foundation from which to create novel products with a broad range of structural and functional variants. Plant oils are an appealing raw material for the plastics sector due to their low cost and abundant availability [6].

Sand apricot (Landolphia kirkii) is a native vine plant located in tropical Africa, noted for its edible fruits. The seeds of Landolphia kirkii contain oil that may be utilised in traditional medicine or cosmetics [7, 8]. The quality and applications of this oil is dependent upon its composition, which can differ across distinct plant species. The sand apricot seed contains a high concentration of nutrients, including lipids, proteins, soluble carbohydrates, and fibres [6, 8]. The oil largely includes unsaturated fatty acids, particularly oleic and linoleic acids [9]. The sand apricot seed has been widely employed in traditional Oriental medicine to mitigate respiratory symptoms and disorders, such as coughing, wheezing, asthma, emphysema, and bronchitis [10]. Additionally, it has been utilised for the management of dermatological conditions including furuncles, acne vulgaris, and dandruff, as well as for alleviating constipation [11] Pharmacological studies indicate that apricot seeds possess antiasthmatic, anti-inflammatory, analgesic, antimutagenic, anticancer, antioxidant, and antibacterial effects [12, 13].

Uvaria chamae, a native plant of West and Central Africa, is utilised for its medicinal characteristics in the treatment of fevers. Furthermore, it demonstrates antimicrobial and antidiabetic properties [14]. The root holds a well-recognized status in African traditional medicine. The plant is esteemed for its hypoglycemic qualities, rendering it a viable option for diabetes treatment [15]. It is widely known as bush banana or finger root because the fruit that develops on its short branches resembles clusters of fingerlike fruit carpels [14, 16]. The distinctive shape has resulted in the adoption of indigenous names like bush banana, which evokes a sense of wildness [15]. Foroutan et al. [17] discovered that both consumable and non-consumable oils have been successfully utilised in biodiesel production. Nonetheless, developing nations like Nigeria depend on traditional diesel, sourced from their crude oil, rather than alternative oil-producing crops such as soybeans, groundnuts, cottonseeds, sunflowers, rapeseeds, oil palm, and coconut oil for fuel [18, 20].

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The incorporation of vegetable oils, or their fatty acids, into formulations with plastic polymers presents a viable opportunity for novel composites. Garrison et al. (2016) assert that the polymerization of FA is plausible due to the presence of several accessible double bonds in its structure. Numerous studies advocate for the alteration of PS to facilitate transformations utilizing renewable raw materials, so incorporating an ecological dimension into the material's strategy. Several studies indicate the incorporation of vegetable fibres into polystyrene (PS) for reinforcement, the inclusion of lignin in the PS formulation for hydrophobic surfaces, the application of polysaccharides in PS-based food packaging, and the utilisation of maize starch for PS copolymerization [18, 19].

The current study seeks to investigate various polystyrene compositions modified with fatty acids derived from vegetable oils, specifically from Sand apricot (Landolphia kirkii) and Uvaria chamae. The synthesis of these novel materials can yield economic and environmental benefits, owing to the utilisation of inexpensive chemicals and their renewable matrix.

MATERIALS AND METHODS

Materials

Potassium disulphate, n-hexane, styrene, sand aricot seed oil, methanol, toluene and aluminum sulphate 18-hydrate were from Scharlau Chemie, Hot plate wooden mould (102 cm x 51cm x 63cm), camry emperors weighing balance, S-metlar balance (electronic)

Sample Collection and Preparation

The samples of dried apricot and uvaria chamae seeds were obtained from Awgu L.G.A. in Enugu State, Nigeria. The study was conducted in the Department of Industrial Chemistry, Enugu State University of Science and Technology, located in Enugu State, Nigeria and Ignatus Ajuru University of Education, Rivers State, Nigeria. The seeds were dehusked to extract the kernels, which were subsequently dried and ground into a fine powder before being kept in a hermetically sealed plastic container.

Extraction procedure

The seeds of apricot and Uvaria chamae were pulverised and air-dried to a particle size of roughly 200 g. Subsequent to weighing and placing them into a thimble, they were positioned within a Soxhlet extractor. Five hundred cubic centimetres of standard hexane and anti-bumping chips were heated on a heating mantle at 70 °C in a 1000 cubic centimetre round-bottom flask to eliminate impurities. The solvent was allowed to get clear before the extraction was terminated. At 40 ◦C, a rotary evaporator was employed to extract and evaporate the solvent from the round-bottom flask. The technique was repeated to obtain an average extraction % and sufficient oil for further testing[8].

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$$\text{Oil content} = \frac{\text{Weight of the oil}}{\text{Weight of sampl}} \times 100$$

Specific Gravity of Seed Oil

The bottle's mass and contents were measured by filling it with distilled water and reweighing it after the mass of an empty, spotless, and dry 50 cm3 density bottle was recorded. Okocha et al. [11] measured the specific gravity of the seed oils by combining the weight of the bottles and oils at 25 oC after measuring the weight of the oils in separate density bottles:

$$\text{Specific gravity} = \frac{\text{Weight of the oil}}{\text{Weight of sampl}}$$

Saponification Value

The volume of each oil sample was 5 cm3, and 50 ml of alcoholic KOH was added to a volumetric flask. After that, the mixture was given half an hour to drain. A 50 cm3 volume of alcoholic KOH was also removed and allowed to drain for half an hour to create a blank. Following its connection to the air condenser, the flask will be heated to a low boil for around an hour. After it cooled, we rinsed the condenser with some distilled water and took it out of the flask. To finish, 1 millilitre of phenolphthalein was added, and the colour would be removed by titrating it with half a millimolar of hydrochloric acid [20].

$$\text{Specific gravity} = \frac{(56 \times (\text{Vo} - \text{V1})}{\text{V}}$$

Where; V0 = the volume of the solution used for the blank test; V1 = the volume of the solution used for determination

Acid Value

Each 25 cm3 of alcohol was dissolved with precisely 2 cm3 of oil sample, which was weighed into a 250 cm3 conical flask. Next, phenolphthalein indicator was added in the form of two drops. Using alcoholic potassium hydroxide, the contents were titrated. A volume of 100 cm3 of titration solvent and 0.5 cm3 of indicator solution were used to conduct the blank titration. Regular standardisation of the KOH solution allowed for the detection of the 0.0005 molarity shift. The sample titration volume (VA) and blank volume (VB) were recorded in millilitres of potassium hydroxide [20].

$$\text{Acid value} = \frac{56.1 \times \text{M}}{\text{W}}$$

Where; A = Amount (mL) of 0.1M KOH consumed by sample, M= Molarity of KOH, W= weight (g) of oil sample.

Iodine Value

The oil sample, measuring precisely 0.4 cm3, was transferred to a conical flask. To dissolve the oil, 20 cm3 of CCl4 was then added. At the end of the allotted period, a measuring cylinder was used to add 125 cm3 of distilled water and 20 cm3 of a solution containing 10% KI (10 g dissolved in 100 cm3) to the mixture. Titration with 0.1M

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sodiumthiosulfate solutions was performed on the material until the yellow colour was almost undetectable. The titration process will involve adding thiosulphate gradually until the blue colouration disappears with vigorous agitation. A little amount of 1% starch indicator was added to start the process. Donlawson et al. [21] used the same methodology for the blank examination.

$$\text{Iodine value} = \frac{(12.69 \times \text{C} \times (\text{Vo} - \text{V1})}{\text{W}}$$

C = Concentration of sodium thiosulphate used, V1 = Volume of sodium thiosulphate used for blank, V2 = Volume of sodium thiosulphate used for determination, W =Mass of the sample.

Peroxide Value

The exact amount of seed oils used was 1.0 cm3. Next, a solvent mixture consisting of 2 cm3 of chloroform and 3 cm of glacial acetic acid was added to a 30 cm3 clean, dry boiling tube, along with 1g of powdered KI. After that, the tube was submerged in boiling water and let to boil violently for no more than 30 seconds, ensuring that the liquid reached a boil within that time. A conical flask was used to swiftly transfer the contents to a solution of 5% KI (5 g dissolved in 100 cm3 of H2O). The tube was rinsed twice with 25 cm3 of water each time before being collected into the flask. According to Ireh et al. (2024), the solution was titrated against a 0.001 M Na2S2O3 solution until the yellow colour faded. Then, 0.5 cm3 of starch was added while shaking vigorously, and the titration was carefully continued until the blue colour faded [21].

$$\text{Peroxide value} = \frac{(\text{V} \times \text{M} \times 1000)}{\text{W}}$$

V= Volume of sodium thiosulphate solution used, M= Molarity of thiosulphate, W=Weight of the oil sample

Polymerization and Plasticization of Polystyrene

A 200-ml beaker was used to dissolve 2.0 grammes of potassium disulfate in 2 ml of water, which was then agitated for 6 minutes. After adding 90 ml of styrene solution, the mixture was heated and agitated until it changed colour from translucent to milky at 87 °C. At 120 oC, the mixture began to become viscous due to the addition of plasticiser (WPO), which was agitated continually until the viscosity began to change colour from milky to brown at 130 oC. At 140 oC, the solution got even more viscous, and plasticity was achieved [22].

Mechanical Properties

The Hounsfield T series universal testing equipment, model-H10KT, was used to investigate mechanical qualities according to ASTM D638 Tensile Test. At a loading range of 100 N and an extension speed of 1 mm min-1, stress/strain curves were produced.

Tensile properties

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The materials examined were subjected to a tensile test following the guidelines laid out by ASTM D 638 utilising testing equipment manufactured by Zwick Roell. The measurements were taken in a controlled environment with typical air conditions and temperatures ranging from 23 to 25°C, with a constant flow rate of 5 ml/minute.Five samples of each polystyrene blend were used for the analysis.

Shore D hardness

A commercially available durometer was used to evaluate the Shore D hardness of the samples under inquiry in line with the ASTM D 2240 standard. We took three readings of each formulation's hardness and averaged them.

RESULTS AND DISCUSSION

Physicochemical Properties Sand apricot and Uvaria chamae Seed Oil

Table 1shows the physicochemical characteristics of Uvaria chamae seed oil and Sand apricot seed oil, including variables like acidity, specific gravity, and oil content.

Table 1: physicochemical properties of Sand apricot and Uvaria chamae seed oil

Oil parameter	Sand apricot seed oi	Uvaria chamae seed oil
Oil conten	10.39	14.56
Specific gravity	0.931 ± 0.21	0.87 ± 0.10
Acid value (mg KOH)	11.083 ± 0.18	9.028 ± 0.32
Peroxide value	12.30	7.2
Iodine value	20.798± 0.40	10.807 ± 0.40
Free fatty acid %	6.30	4.015
Saponification values	283.271	173.392
Refractive index	1.412	1.80
Viscosity	85.23	65.89

The oil content of the Sand apricot seed oil and Uvaria chamae seed oil were extracted with hexane, and the estimated values were 10.39% and 14.54%. Uvaria chamae seed oil had a relatively higher oil percentage yield than Sand apricot seed oil. In a comparable study, Amos-Tautua and Onigbinde [23] found that groundnut and maize had a low oil content of 10.54% and 6.63%, respectively, but soybean had a relatively high oil content of 16.51%. Chatepa et al. [24] reported the comparatively high oil content of 34.91±0.93, 46.05±0.19, and 31.65±0.44 for M.

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oleifera, P. curatellifolia, and A. digitata seeds. The limited oil content of vegetables can impact the accessibility and cost effectiveness of oils and other food products generated from these plants. Seeds with a high proportion of free fatty acids (FFA) (> 1% w/w) are responsible for both poor oil yield and the production of soap (Garrison et al., 2016). The specific gravity of Sand apricot seed oil and Uvaria chamae seed oil is 0.931 ± 0.21 and 0.87 ± 0.10. This signifies that the oils have a lower viscosity than water and do not contain any dense components. The measurement of specific gravity is vital as it directly affects the energy density, also known as specific energy, of petrol [11, 25].

The acid value is a crucial property in numerous industries, such as food processing, biodiesel manufacture, and cosmetics. The acid value of the extracted Sand apricot seed oil and Uvaria chamae seed oil was reported as 11.083 ± 0.18 and 9.028 ± 0.32. AmosTautua and Onigbinde [23] discovered that the acid values for soybean and groundnut were 19.21 and 4.63, respectively, in a related investigation. Chatepa et al. [24] observed an acid value of 2.68±0.01 for groundnuts and 9.46±0.02 for pigeon pea. The oil's low acid levels imply a reduced susceptibility to rancidity, a chemical deterioration process in which free fatty acids and other degradation products can adversely influence the oil's flavour and aroma [20]. Another effect of low acid values is better stability during the processing phase and lower equipment corrosion.

The iodine values of Sand apricot seed oil and Uvaria chamae seed oil were 20.798 ± 0.40 and 10.807 ± 0.40, respectively, both of which were lower than the iodine value of castor oil (84.8 gI2/100g)[26], as well as the iodine values of soybean (73.02 gI2/100g) and pigeon pea (69.64 ± 5.19) [24]. The iodine value of the oil surpassed the 1.85 threshold established by Konuskan et al. (2019) for rubber seed. This implies that the oil will eventually become unstable and prone to rancidity or peroxidation [8].

The iodine value quantifies the amount of unsaturated fats and oils in the sample. The low iodine value of Sand apricot seed oil and Uvaria chamae seed oil indicates a diminished degree of unsaturation, signifying a higher concentration of saturated fatty acids [6, 11]. Oils with low iodine levels generally demonstrate increased stability and less vulnerability to oxidation. These characteristics render them ideal for applications requiring stability and rancidity resistance, such as in the manufacturing of cooking oils and food processing [15, 27]. The intrinsic stability of oils with low iodine values prolongs the durability of products developed from these oils. This is particularly beneficial in the food industry, where there is a demand for products with prolonged shelf life before spoilage [26].

The peroxide values of Sand apricot seed oil and Uvaria chamae seed oil were determined to be 12.30 and 7.29 ± 0.00 Meq/kg, respectively, both of which are below the standard established by NIS [28]. Increased peroxide readings indicate a

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notable occurrence of oxidative rancidity in the oils, along with a lack or inadequate levels of antioxidants. Nonetheless, certain antioxidants such as propyl gallate and butylated hydroxytoluene might be utilized to reduce rancidity [29].

The fatty acid content of Sand apricot seed oil and Uvaria chamae seed oil was measured at 6.30% and 4.015%, respectively [7]. Their study revealed a comparatively low concentration of α-linolenic acid (0.63 to 1.36%) when contrasted with the "Dezful" oil (4.60%) obtained from pomegranate seed oils. The presence of trace levels of free fatty acids in seed oil correlates with greater quality, increased durability, and improved versatility for various applications in the food, industrial, and pharmaceutical sectors [11, 30]. The research by Maňourová et al. [31] assessed the saponification values of Sand apricot seed oil and Uvaria chamae seed oil at 283.271 and 173.39 mg KOH/g, respectively.

Mechanical Properties of Polystyrene Blend with Vegetable Oils

Polystyrene blends with vegetable oil and ultimate tensile strength (UTS)

Table 3 illustrates the data on polystyrene blends with vegetable oil and their ultimate tensile strength. The table presents the ultimate tensile strength of polystyrene combined with varying percentages of Sand apricot seed oil, Uvaria chamae seed oil, and white petroleum.

Table 3: Polystyrene blends with vegetable oil and ultimate **tensile strength**

	Ultimate **tensile strength**		
% PS-Blends	PS-SA (Mpa)	PS-UC (Mpa)	PS-WP (Mpa)
100:0	58.6	50.4	50.6
80:20	55.2	44.2	48.6
60:40	44.0	40.0	46.4
40:60	41.9	37.5	45.3

The ultimate tensile strength (UTS) of PS-SA and PS-UC was measured at 58.6 MPa and 50.4 MPa, respectively, whereas PS-WP exhibited a UTS of 50.6 MPa at a 100:00 blend ratio. The ultimate tensile strength of PS-SA exceeded that of PS-UC, which was consequently lower than that of PS-WP. The data indicated a rise in the UTS with an increase in the concentration of the plasticiser. The elevated UTS indicates that PS-SA and PS-UCS are suitable for the design of structural elements in civil engineering, mechanical engineering components, and medical applications, including orthopaedic implants [8]. Barzegari et al. [22] identified a significant ultimate tensile strength characteristic in densely packed polystyrene containing lignin. In a similar

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study, Das et al. [33] examined the impact strengths and enhanced mechanical properties of blends consisting of unsaturated polyester resin, styrene, and tung oil. Figure 1 depicts the ultimate tensile strength of polystyrene blended with vegetable oil. The chart indicates that PS-SA possesses the highest Ultimate Tensile Strength (UTS).

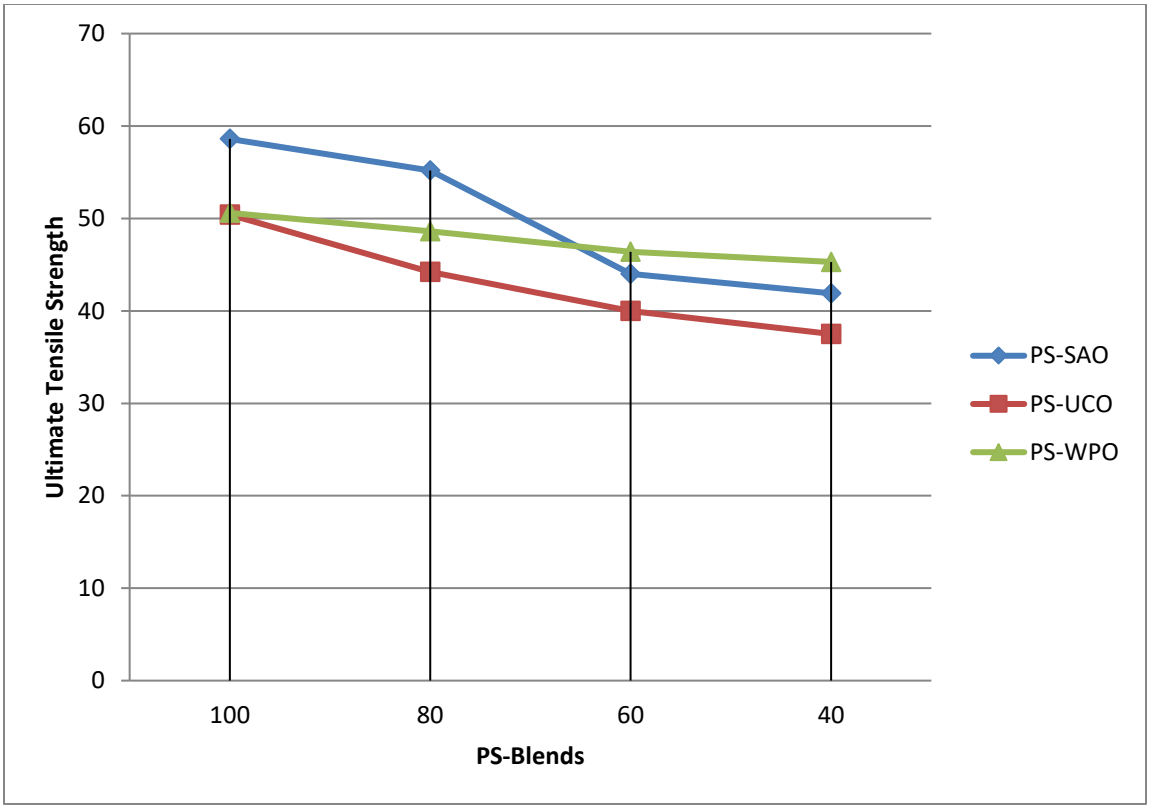

Figure 1: Polystyrene blends with vegetable oil and ultimate tensile strength

Polystyrene blends with vegetable oil and Young modulus

The Young modulus of data of polystyrene blends with vegetable oil is illustrated in Table 4. The Young's modulus of PS-SA and PS-UC was measured at 1954.0 and 1986.4, respectively, at a 100% blend, whereas PS-WP was measured at 1996.1. The Young's modulus of PS-UC surpassed that of PS-SA, while PS-WP exhibited the greatest Young's modulus, indicating superior stiffness and less deformation under elastic stresses. The augmentation of plasticiser enhanced the rigidity of the polystyrene polymer mix [2, 3, 34]. Figure 2 depicts the Young's modulus of polystyrene blended with vegetable oil. The chart shows that PS-WP has the highest Young modulus.

Table 4: Polystyrene blends with vegetable oil and Young modulus

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	Young modulus		
% PS-Blends	PS-SA	PS-UC	PS-WP
100:0	1954.0	1986.4	1996.1
80:20	1797.9	1878	1985.3
60:40	1996.1	1954.0	1887.8
40:60	1878.4	1797.9	1954.0

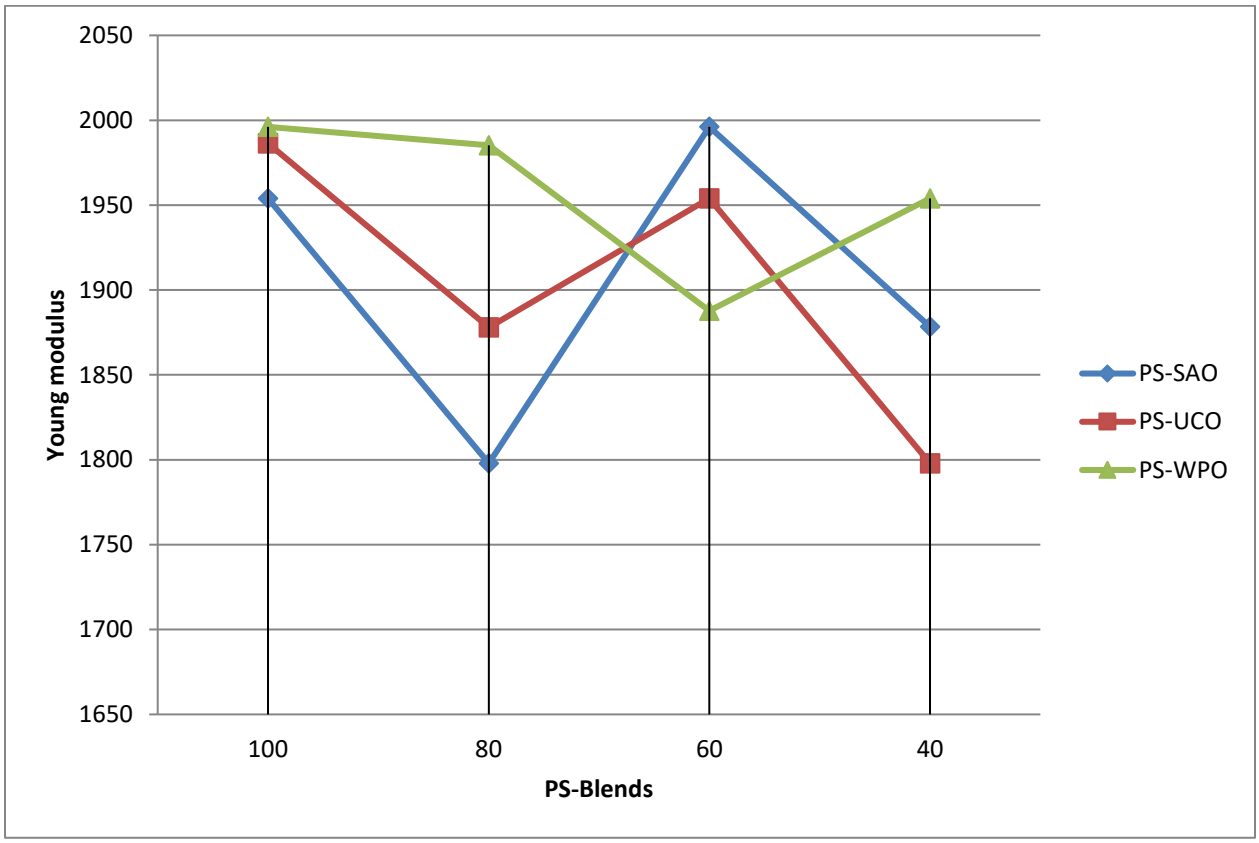

Figure 2: Polystyrene blends with vegetable oil and Young modulus

Polystyrene blends with vegetable oil and % elongation

The percentage elongation of polystyrene blends with vegetable oil is illustrated in Table 5.

The percentage elongation of PS-SA and PS-UC was observed at 13.4 and 12.3, respectively, at a 100% mix, while PS-WP was measured at 12.6. The percentage elongation of PS-SA exceeded that of PS-UC and PS-WP at all concentrations employed in the polymerisation reaction. This phenomenon is ascribed to the comparatively low Young's modulus of the PS-UC, with the percentage elongation of both PS-WP and PS-UC

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increasing as the Young's modulus diminishes. According to Table 5, PS-SA and PS-UC with reduced plasticiser concentrations exhibit the maximum percentage elongation of 54.2% and 49.5%, respectively [3].

Table 5: Polystyrene blends with vegetable oil and Percentage elongation

	Percentage elongation		
% PS-Blends	PS-SA	PS-UC	PS-WP
100:0	13.4	12.3	12.6
80:20	21.1	20.1	18.1(69.8)
60:40	39.5	30.7	22.1(286.1)
40:60	54.2	49.5	30.4

The results correspond with the observations of Garcia-Garcia et al. (2018), who recorded a notable enhancement in % elongation and superior mechanical properties of poly (3-hydroxybutyrate). Mishra & Naik [35] reported Young's modulus values of 12264 MPa and 446 MPa for banana-fibre polystyrene composites in a comparable investigation. Figure 3 illustrates the percentage elongation of polystyrene when blended with vegetable oil. The graphic indicates that PS-SA exhibits the largest percentage of elongation.

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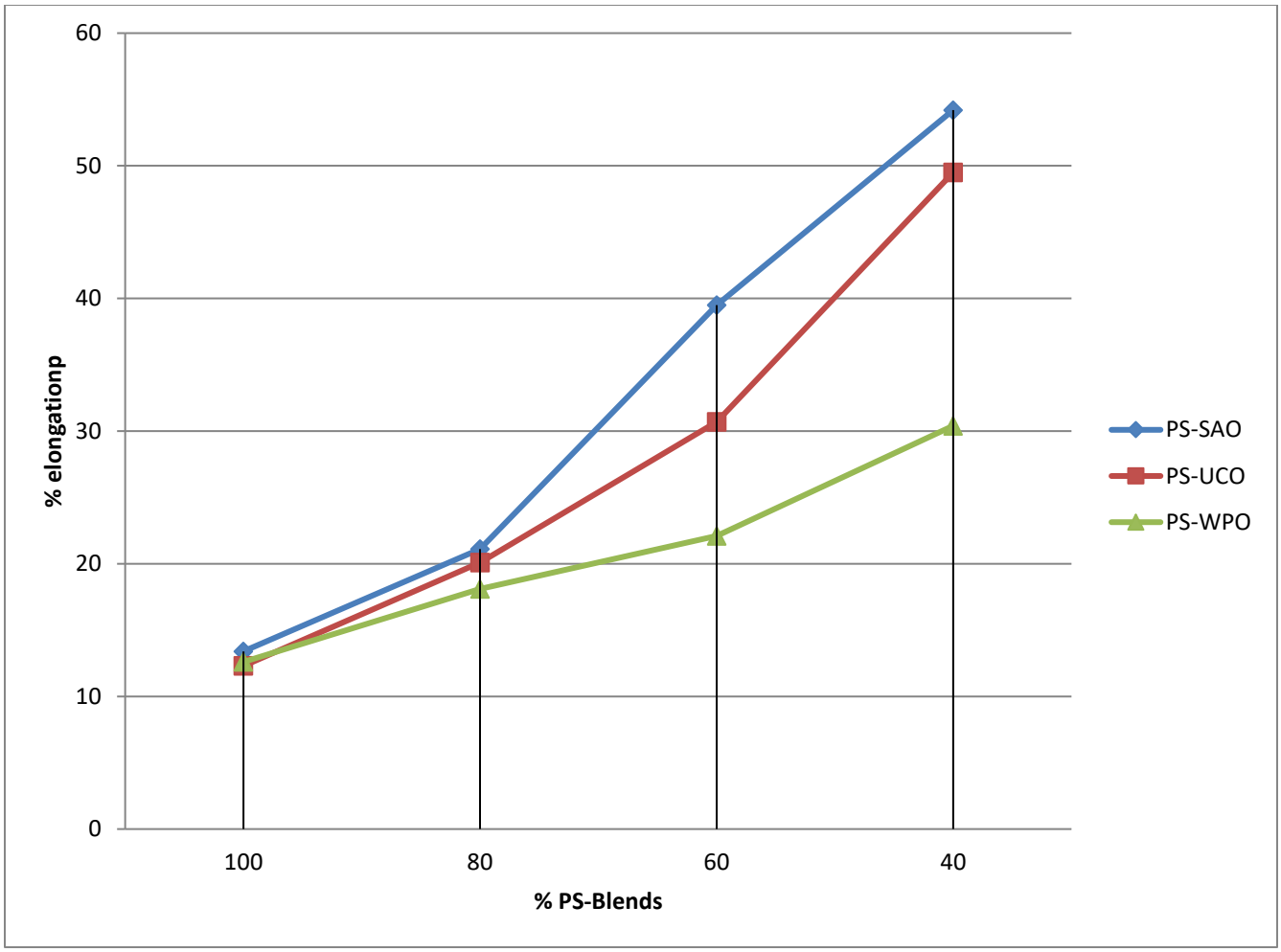

Figure 3: Polystyrene blends with vegetable oil and % elongation

Polystyrene blends with vegetable oil and break load

The break load is the maximum force or stress that a material can withstand before it fails or breaks. The break load of polystyrene blends with vegetable oil is illustrated in Table 6.

Table 6: Polystyrene blends with vegetable oil and break load

	Break load (N)		
% PS-Blends	PS-SA	PS-UC	PS-WP
100:0	500.6	300.6	400.4
80:20	419.8	219.8(-19.9)	398.8
60:40	317.9	200.1	356.9
40:60	311.2	194.8	317.9

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The break loads of PS-SA and PS-UC were documented at 500.6N and 300.6N at a 100% mix, whereas PS-WP was assessed at 400.4N. The break load of PS-SA exceeded that of PS-UC and PS-WP, but the break load of the polystyrene blend diminished with a reduction in plasticiser content. These results indicated that PS-SA would marginally endure more loads than PS-UC. Polystyrene polymers exhibiting a low peak load may possess increased brittleness and diminished capacity to endure substantial loads [35]. They may be appropriate for applications necessitating low strength but may not be optimal for scenarios where durability and resistance to mechanical stress are essential [36]. Figure 4 illustrates the break load of polystyrene blended with vegetable oil.

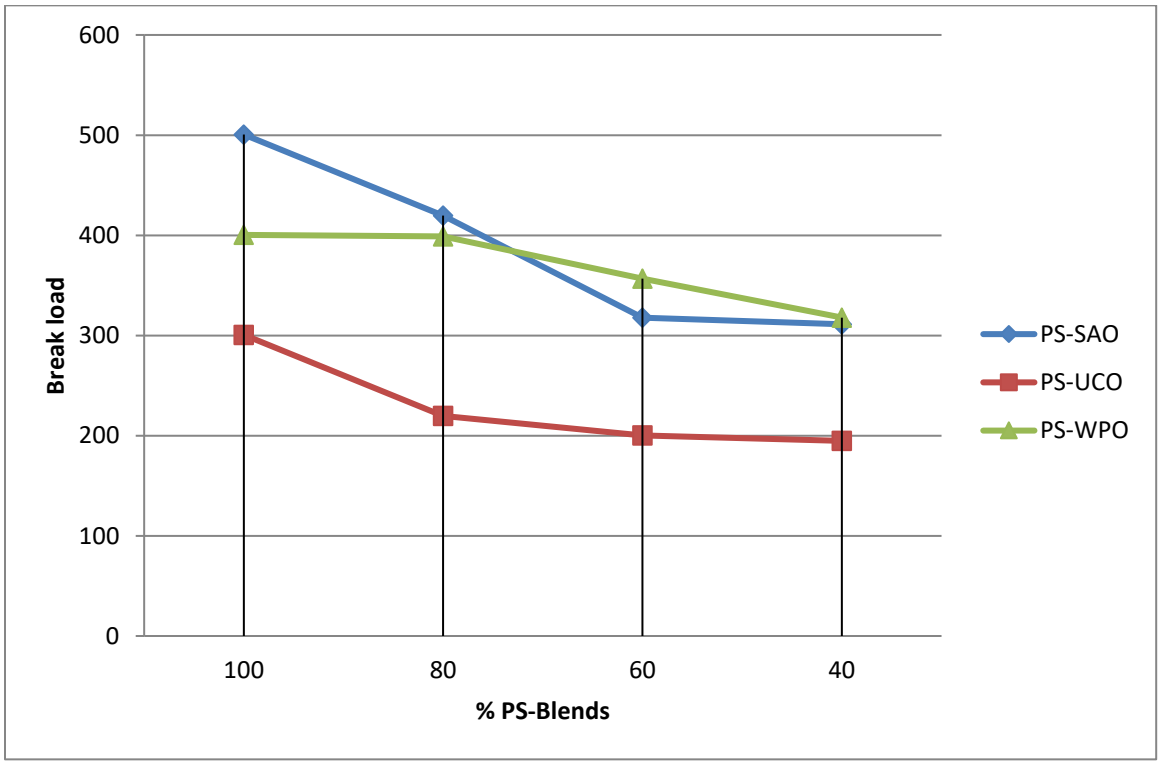

Figure 4: Polystyrene blends with vegetable oil and break load

Polystyrene blends with vegetable oil and Shore D hardness

The Shore D hardness of polystyrene blends with vegetable oil is illustrated in Table 5.

The Shore D hardness values for PS-SA, PS-UC, and PS-WP were measured at 80.0, 79.0, and 83.0, respectively. The elevated Shore D hardness of polystyrene signifies that the material is comparatively inflexible and resistant to indentation [2, 30].

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Table 6: Polystyrene blends with vegetable oil and Shore D hardness

	Shore D hardness		
% PS-Blends	PS-SA	PS-UC	PS-WP
100:0	80.0	79.0	83.0
80:20	78.2	77.2	78.2
60:40	74.4	74.4	74.4
40:60	72.4	72.4	73.0

The estimated values imply that PS-SA and PS-UC polymers are harder and less flexible. This attribute is advantageous in scenarios where the material must preserve its form and withstand deformation under stress. PS-SA and PS-UC may be utilised in hard packaging, durable containers, or structural elements necessitating significant stiffness [35, 37, 38]. Figure 5 depicts the correlation between the polystyrene blend and Shore D hardness.

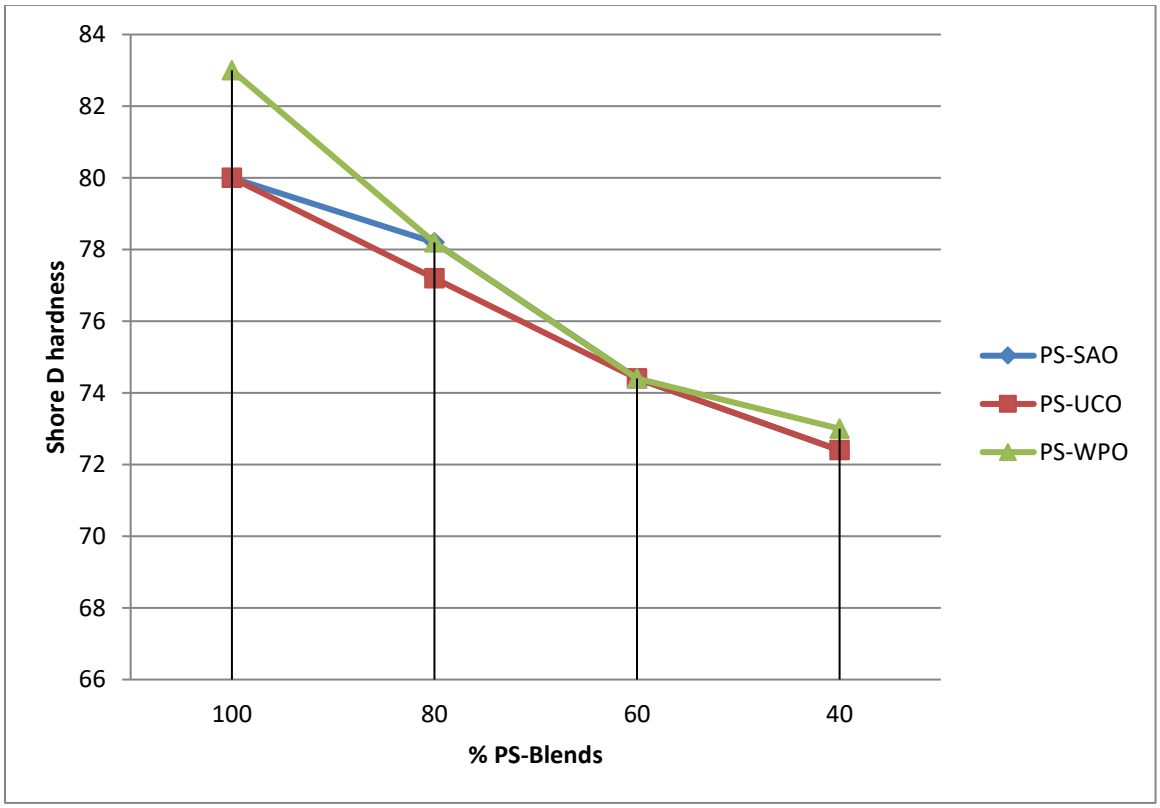

Figure 4: Polystyrene blends with vegetable oil and shore D hardness

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CONCLUSION

Polystyrene treated with different oils—Sand apricot and Uvaria chamae—was the main subject of the study. Oil quality investigations showed that both SA and UC had high saponification values, whereas SA seed oil had greater values. This proves that both seeds can be used to make soap. Furthermore, SA had a higher viscosity than UC, suggesting that it can be utilised to enhance component sealing, avoid leaks, and maintain an adequate barrier between various systems. SA has a higher iodine value than UC, which suggests that it contains more unsaturated fatty acids.

The mechanical properties of polystyrene were discovered to be enhanced when it was changed with seed oils of sand apricot and Uvaria chamae. This was especially true in the areas of ultimate tensile strength, Young modulus, peak load at break, and shore D hardness. In contrast, PS-UC and PS-SA % elongation decreases with increasing blend concentration. The results show that the mechanical properties of the polystyrene blend with SA and UC are good for packaging, and it is very suited and long-lasting. Based on the findings, researchers, engineers, and manufacturers will be able to enhance the polystyrene products' overall performance, dependability, and safety.

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