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EFFECT OF DIFFERENT SOLVENTS AND PROXIMATE COMPOSITION ON THE EXTRACTS OF GLYCINE MAX OIL

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ABSTRACT

Soya bean oil was extracted from the seed of soya bean (glycine max) using solvent extraction method, which required the optimum maximum yield of each of the solvent used per parameter. The parameters considered include, moisture content, ash content, crude fat (liquid), crude fibre, crude protein and carbohydrate content. The results obtained from the proximate analysis of each of the parameter used, are; moisture content, 8.30 $\pm$ 0.04 (petroleum ether) and 5.0 $\pm$ 0.04 (isopropanol/Alcohol); Ash content, 9.01 $\pm$ 0.1 (petroleum ether) and 6.30$\pm$0.03 (isopropanol), crude fat (liquid) is 21.47 $\pm$ 0.08 for isopropanol, crude fat is 19.02 $\pm$ 0.04, crude fibre is 2.45 $\pm$ 0.03, for isopropanol, crude fibre is 1.35 $\pm$ 0.23, crude protein 37.51 $\pm$ 2.46, isopropanol crude protein is 34.60 $\pm$ 0.12 and the carbohydrate content for petroleum ether is 21.26% while for isopropanol/alcohol is 33.72%. The above results, which are expressed as mean $\pm$ S.E.M indicates that protein has a high percentage yield than other parameters, and carbohydrate content in isopropanol/alcohol has higher percentage yield than petroleum ether therefore, the totality of the result indicates that petroleum ether has higer oil yield than isopropanol/alcohol of above 95%.

Keywords: Soybean, proximate analysis, isopropanol, petroleum ether, percentage yield

1. INTRODUCTION

Soya bean oil is a vegetable oil extracted from the seeds of the soya bean (Ghycine Max). It is one of the most widely consumed cooking oil. As dry oil, processed soya bean oil is also used as a base for printing ink (soy ink) and oil paints. Oils from most edible oil seeds are used in the food industry, though, there is growing emphasis on industrial utilization of feedstock for several industries with about 80% of the world's production of vegetable oils for human consumption. The remaining 20% utilization is between animal and chemical industries (1). There has been an increase in the world production of oil seeds over the last thirty years (1); this would appear to be related to the increasing demand for oil seed products and by-products as oil seeds are primarily grown for their oil and meal. Vegetable oil is always priced better than per ton of its cake, this is because the demand for oil is often higher than the cake.

According to (2), bio-oils from oil seeds are used as straight vegetable oil (SVO) or as bio-diseal (transesterified oil), depending on type of engine and level of blend of the oil; soya bean oil is not an exception. This phenomenon has created a school of thought, that it is better to use oil seeds as bio-fuels, which will lessen the competition for fossil fuel, which are not renewable. Fossil fuels are not only costly in terms of price, but are also costly to the ecosystem as they

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degrade land, pollute water and cause a general destabilization of the ecosystem with global warming as an end result.

Nevertheless, the petroleum industry requires a greater quantity of oil to meet its demand. Demand, however, by the food industry alone is not secure for many developing countries like Ghana that depend on imports of vegetable oil and fossil fuels. In order to meet the required amounts needed by all industries, these fats and oils must be available large quantities locally with an effective extraction process at an affordable cost. The ability of a particular oil seed to fit into the growing industries depends on its utilization potential, rate of production, availability and ease of the processing technology. Thus while some oil seeds are being largely utilized in the oil processing industries; quite a number of oilseeds are underexploited.

Generally, fats and oils, together with protein, carbohydrates, vitamins and minerals, are the main nutrients required by the human body. Fats and oils are rich in energy. In addition to soybean being a source of vitamins A, D, E and K, fats and oil it also contain essential fatty acids, which are not manufactured by the body but must be obtained from diets, with Linoleic, oleic and linolenic acids as examples of unsaturated fatty acids (3). Soybean also rich in vitamin B_1, B_2, B_6, niacin, folate and minerals (4). Modern processing of vegetable oils yields valuable products such as oleo chemicals. Oleo chemicals are now largely being used in the manufacture of many industrial products, namely; building auxiliaries, candles, detergents and clearing agents, cosmetics, fire ex-tingushing agents, floatation agents, food emulsifiers, insecticides, lubricants, paints, paper, medicine and chemicals.

2.1MATERIALS AND METHODS

Sample collection and treatment

Glycine Max (perennial) variety of soya bean was obtained from the grain seller in Keffi central market, Nasarawa State. The sample was milled and sieved, then categorized into fine (brokers retained a sieve size 180 jem). The samples were then conditioned to obtain samples at moisture contents of 7% and 4.5%.

Data of various types were collected for the study and these included proximate composition data, flow quantity of oil per time, moisture and solvent. Equipment used for the study included a soxhlet apparatus, desicator, drying oven, weighty scale, furnace chamber, and chemicals such as petroleum ether and isopropanol/alcohol. For oil extraction, a complete randomized design (CRD) with a two way treatment was used. All treatments were in triplicates.

Sample Analysis

Determination of moisture content

The % moisture lost was measured due to drying at a temperature of 105^0C. According to Udo and Oguwele, 1986 (5) method, with modifications, 1g of the solvent sample was weighed (W_1) into pre-weighed crucible (W_0) and placed into a hot dried oven at 105^0C for 3hours. The crucible were removed, cooled in a desicator and weighed. The process of drying, cooking and weighting were repeated until a constant weight (W_2) was obtained. The weight loss due to moisture was obtained by the equation:

Moisture (%) $= W_1 - W_2$

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$$\frac{}{W_1 - W_0} \text{ X } 100$$

Where

W_0 = weight of the empty crucible (g)

W_1 = weight of the sample solvent + empty crucible (g)

W_2 = weight of the dried sample + empty crucible (g)

Determination of Ash content

According to James, 1995 (6), 1g of the solvent sample was weighed (w_1) into a pre-weighed crucible (W_0) and placed into a lanton muffle furnace at 550^0C for 5hours. The ash was cooled in a desicator and weighed (W_0). The weight of the ash was determined by the difference between solvent sample, pre-weighed and the ash in the crucible. Percentage ash obtained by the equation below;

$$\text{Ash (\%)} = \frac{W_2 - W_0 \text{ X } 100}{W_1 - W_0}$$

Determination of crude fibre content

Crude fibre was determined by developing the method of Udo and Oguwele 1986 (5). 1g of solvent sample was weighed (W_0) into a crucible. It was then allowed to dry overnight for 105^0C in air oven. It was then removed and cooked in a desiccator. The sample was weighed (W_1) and ashed at 55^0C for 90mins in a lanto muffle furnance. It was finally cooked in a desiccator and weighed again (W_2). The percentage crude fibre was calculated using;

$$\text{Crude fibre (\%)} = \frac{W_1 - W_2}{W_0 \text{ X } 100}$$

Determination of crude fat

The crude fat content was determined by the method Udo and Oguwele, 1986 (5). 1g of the solvent sample was weighed (W_0) into a crucible, and was then dried for three hours in an oven at a temperature of 105^0C and weighed (W_2). It was then weighed (W_1) to get the percentage yield of the crude fat which was calculated using the equation below;

$$\text{Crude liquid (\%)} = \frac{W_1 - W_2}{W_0 \text{ X } 100}$$

Determination of crude protein

Kjeldahl digestion and distillation method was used to determine the percent nitrogen content of the sample according to AOAC, 1990 (7), using the following steps:

Digestion, distillation and titration

1g of sample was put into micro-Kjeldahl flask and 10ml of concentration H_2SO_4 and Kjeldahl catalyst (Titanium) and pumice chips were added. The flask was then placed on the digestion heater and heated for 4 hours until the solution became clear. After cooking, the solution was transferred into 50ml volumetric flask and made up to the mark with distilled water.

3 drops of mixed indicator (a mixture of bromocresol green and methyl red) was added to 5ml of 2% boric acid (H_3BO_3) in 250ml conical flask. 5ml of digested samples was pipette into the

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markhan distiller and 10ml of 40% N_aOH was added. This was distilled into the conical flask until the distillate reached above 50ml.
The distillate of the sample was titrated against 0.1M HCL using a mixed indicator to a grey coloured end point. The titre value was recorded.

Protein was determined by first calculating the percentage nitrogen which is given as;

$$\% \text{ Nitrogen} = \frac{0.014 \times M \times V \times 100}{\text{Weight of sample}}$$

Where

M = Molarity of Acid (0.5)
V = End point of titration

Crude protein is then calculated by multiplying the % Nitrogen with 6.25 and adding it to the crude protein.
i.e. crude protein= % nitrogen × 6.25
Where 6.25 is the conversion factor.
Determination of carbohydrate
The method of James, 1995 (6) was adopted, where the total proportion of carbohydrate in the oil yield sample which was obtained by calculation using the percentage dry method. This is by subtracting the % sum food nutrient, % protein, % crude liquids, % crude fiber, and % moisture/% ash from 100%. This is done by using the equation below;

CHO (%) =100% - (% crude protein + % crude liqid + crude fibre + % ash + moisture)

Procedure for oil extraction

80g of the milled soya bean sample conditioned at moisture contents of 7.0% and 4.5% were used for the extraction process using soxhlet apparatus. 250ml of each solvent was measured into the 250ml round bottom flask and heated at a constant temperature of 500C to reflex. The heat caused the solvent to vaporize through the thimble containing the anti-bombing agent in flat bottom flask. The sample, as the solvent boiled in the flask; the vapour was trapped and cooked by the condenser above the thimble. The cooking turned the vapour into warm liquid which hydrolysed the sample in the thimble. When the thimble was filled with the drops of the warm solvent from the condenser, the solvent (which conform traces of oil) was poured into the flat bottom flask beneath the thimble containing either petroleum ether or isopropyl alcohol automatically through a siphon arm. The process was continued for the duration of 8 to 22 hours for each replicate.
At the end of each extraction process, the milled sample was removed from the thimble and the extraction process repeated for solvent recovery from the oil sample, under an unspecified time, depending on the quantity.
The oil was poured into a beaker and placed on a steam bath and finally dried in the oven for 30mins, at 103^0C, the amount of oil extracted was determined by pouring the oil into a measuring cylinder.

Statistical calculation

A test of significance (P-test) was carried out on the mean of each of the proximate analysis using a computer software- Statistical Package for Social Sciences version 15.0 (SPSS 15.0)

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which showed that there was a significant difference ($p<0.05$) in the analysis among the various processing methods of extraction.

3. RESULTS AND DISCUSSION

Table 1 showed the result of the proximate analysis. Protein content was highest in the soya bean sample followed by fats & ash, carbohydrate has high yield content of oil with isopropanol (33.72%), then petroleum ether (12.26%) of oil respectively. This study showed that the protein measured in the experiment could be attributed to agronomic practice and varietal difference of the samples (8). This conform with work of other researchers on proximate analysis, and the essential amino acids of *glycine max* (4; 9)

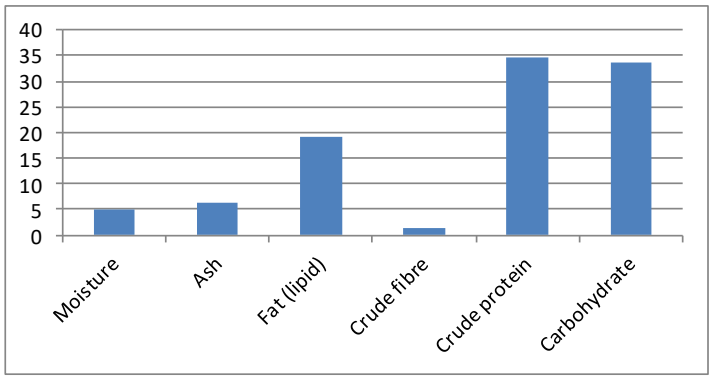
Table 1: proximate composition of soybean extracts

Parameter (%)	Petroleum ether (%)	Isopropanol/alcohol
Moisture content	8.30 ±0.04	5.01 ±0.014
Ash content	9.01 ±0.01	6.30 ±0.03
Crude fat (lipid)	21.47 ± 0.08	19.02 ±0.04
Crude fibre	2.45 ± 0.03	1.35 ±0.23
Crude protein	37.51 ± 2.46	34.60 ±0.12
Crude carbohydrate	21.26	33.72

The result is expressed at mean ±S. E. M. (n=3)

Soya bean oil seeds (glycine max) occur about 80% of the worldwide production of vegetable oil for human consumption. Table 1 indicates that among the parameters used in determination of proximate analysis, protein has a higher oil content compared to other six parameters, in terms of petroleum ether. Although carbohydrate content using isopropanol/alcohol showed percentage higher yield than petroleum ether. The result of study that various parameters contributed to the extraction optimization of soya bean oil as the petroleum ether gave higher oil yields as compared to isopropyl/alcohol with lower oil extracts.

Figure 1 **Proximate Compositions of Soya Beans Petroleum ether extract**



This could be attributed to the reaction between the solvent and the oil extract which resulted in the formation of little oil yield (10-13) from the solvent characteristics, both solvents are

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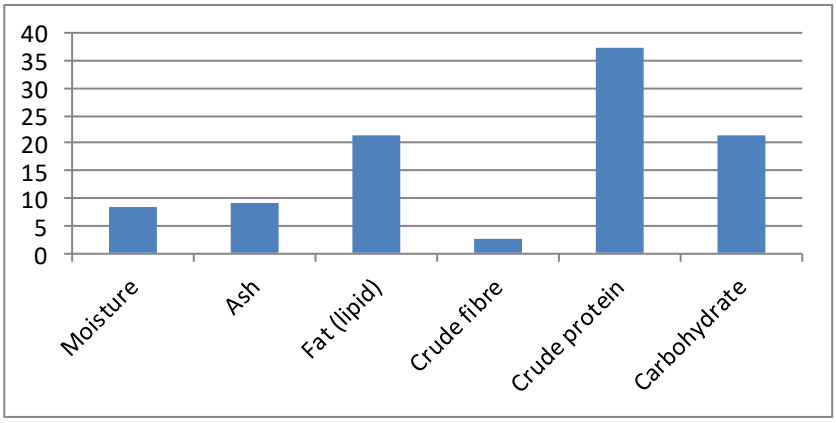
considered to be less hazardous, compared to isopropanol/alcohol through petroleum ether has a higher boiling point than isopropanol/alcohol. The texture of the ground (milled) sample had a great impact on the quantity of oil extracted, as sample that were milled had a greater yield regardless of the solvent used. The result confirms the assertion that for optimum oil recoveries, seed cells must be ruptured finely enough to enable solvents extraction of the oil.

Figure 2: Proximate Compositions of Soya Beans Petroleum ether extract



This study conforms to the work of (14-17) isopropanol/alcohol and petroleum ether give good percentage yield as solvents extractor. Results based on the pre-determined crude fat contents had no significant effect on oil output, indicating that once seeds are dried to the recommended fat content (7.0%) further drying will not be necessary. Further drying of seeds will only increase the cost of production which will not affect yield of the extracts. Soyabean, being a vegetable oil, is a good source of plant sterols, especially β-sitosterol. The FDA has approved the following claim for phytosterols (18). Food containing at least 0.4g per serving of plant sterols eaten twice a day with meals for a daily total intake of at least 0.8g as part of a diet low in saturated fat and cholesterol, may reduce the risk of heart disease "phytosterols competitively inhibit (4).

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