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Biochemical Characterization of Oil from Groundnut (*Arachis hypogaea* L.) Genotypes

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Authors' contributions

This work was carried out in collaboration between all authors. All authors read and approved the final manuscript.

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ABSTRACT

Groundnut (*Arachis hypogaea* L.) is an important food item around the world. It is a crop that bears its seeds in underground pod, rather than on the aerial parts of the plant. The groundnut seeds or kernels have nearly 50 percent oil (triglycerides). Groundnuts is widely used in Asia and Africa to produce groundnut oil, which forms less smoke when frying than some other types of oils. In the present study various parameter for oil quality have been determined such as oil content (%), saponification value, iodine value, acid value and peroxide value in 24 genotypes of groundnut. The oil content in genotype was UG-172 (46.43%) was maximum, followed by UG-174 (46.33%) whereas the genotype UG-184 (41.83%) had minimum oil content. Genotype GG7 showed maximum saponification i.e. 215.23 mg/gm, followed by UG172 i.e. 209 mg/gm while minimum saponification value found in UG181, 145.32 mg/gm. Maximum acid value was observed in genotype UG165 0.698 mg/gm and minimum acid was value observed in genotype UG160 0.060 mg/g. Maximum iodine value was seen in genotype UG181 and UG 172 *i.e.* 91.21 and 90.20,

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respectively. Minimum Iodine value was observed in genotype UG162 (55.90). Maximum peroxide value was found for genotype UG163 (45.60 milli equivalent peroxide / kg per sample) followed by minimum peroxide value in genotype UG160 9.30 milli equivalent peroxide / kg per sample.

Keywords: Oil content; saponification value; acid value; peroxide value; iodine value.

1. INTRODUCTION

Groundnut (*Arachis hypogaea* L.) is an annual warm-season crop of the legume family that originated in South America and groundnut has been cultivated since ancient times. Groundnut is a member of *Papilionaceae* subfamily of the *Fabaceae* family which comprises important edible oil seed crops in the world. India, China, Nigeria, Senegal, Sudan, Burma and the USA are the major groundnut-producing countries of the world. Groundnut is an important crop internationally for both direct human consumption and as an oilseed mop, which is being cultivated in 108 countries of the world. Among the oilseed crops, groundnuts are a good source of oil containing higher amounts of unsaturated fatty acids as compared to saturated fatty acids [1], besides this they provide characteristic flavour and texture to the food as integral diet component. In India, 80% of the groundnut produce is crushed for extraction of oil and accounts for 36.10% of the total oil production. Groundnut seed contains 44 – 56% oil and 22 – 30% protein on a dry seed and is a rich source of mineral (Phosphorous, calcium, magnesium and potassium) and vitamins E, K and B group. Groundnut may be one of the most cardioprotective foods readily consumed according to the groundnut institute thus the quality as well as quantity concerned during diversity analysis.

In the present study, percent oil content, acid values, saponification values, peroxidise value and iodine value of 24 groundnut genotypes were examined for the selection of best genotype.

2. MATERIALS AND METHODS

Mature pods of 24 groundnut genotypes were collected from Department of plant breeding and genetics, RCA, Udaipur. The seeds and pod shells were separated manually. The mature and healthy seeds were ground and stored for analysis. These are the segregating generation of groundnut used in breeding program to develop high quality variety of groundnut.

2.1 Estimation of Oil in Groundnut Seed by Soxhlet Apparatus

Oil was extracted in 24 genotypes of groundnut using Sadasivam and Manickam [2] method using petroleum ether as a solvent. It is then distilled off completely, dried, the oil weighed and the percentage oil is calculated.

> Oil in ground sample % = Weight of oil (g) x 100 / weight of sample (g).

2.2 Estimation of Acid Value

The amount of free fatty acid present in groundnut oil has rational effect on its quality. The acid value analysis was carried out with method of Pushpa Seth and S. K. Khandelwal [3].

In this method oil sample was suspended in a solvent and then titration was carried out with KOH.

> Acid value (mg KOH/g) = Titre value x Normality of KOH x 56.1/Weight of the sample (g).
>
> The free fatty acid is calculated as oleic acid using the equation 1 ml N/10.
>
> KOH = 0.028 g oleic acid.

2.3 Estimation of Saponification Value

Saponification value of 24 groundnut genotypes was determined according to [4]. Two grams (2.0 g) of the oil was weighed into a flask. Twenty five millilitres (25 ml) of alcoholic KOH was pipetted and allowed to drain for about 1 min into the mixture. A blank determination was prepared and determined simultaneously with the sample. A condenser was connected to the flask and the mixed sample was allowed to boil gently and steadily for 45 min for complete saponification. The flask and condenser were then cooled but not sufficient to form a gel. The condenser was disconnected and 1 ml of phenolphthalein indicator was added to the content of the flask. The solution was titrated with 0.5 N HCl until the

pink colour just disappeared. The saponification value was calculated using the formula-

Saponification value = (B – S) X 56.1 X N / Weight of oil sample.

Where, B = Blank titre value, S = Sample titre value and N = Normality of HCl.

2.4 Estimation of Iodine Value

Iodine value was determined according to AOCS method [4]. An amount of 0.2 g of the oil was accurately weighed into a 500 ml flask. Fifteen millilitres (15 ml) of carbon tetrachloride was added as a solvent to the sample and that the sample completely dissolved in it. Twenty five millilitres (25 ml) of Wij's solution was then pipetted into the flask containing the sample and mix well. The sample was then placed in the dark for 30 min at room temperature. The flask was removed from storage and 20 ml of 10% KI solution added, followed by 150 ml of distilled water. The mixture was titrated with 0.1 sodium thiosulphate solution, adding gradually and with constant and vigorous shaking until the yellow colour had almost disappeared. Further1.5 ml of starch indicator solution was added and the titration was continued until the blue colour disappeared. A blank determination was conducted simultaneously. The iodine value was calculated using the formula:

Iodine value = $B-S \times N \times 12.69$/Weight of sample.

Where, B = Blank titre value, S = Sample titre value and N = Normality of $Na_2S_2O_3$.

2.5 Estimation of Peroxide Value

Peroxide value was determined according to Pushpa Seth and S. K. Khandelwal [3] method. Peroxide value is a measure of the peroxide in the oil. The peroxide is determined by method of titration against thiosulphate in the presence of KI. Starch is used as indicator. In this method 1 ml of oil was mixed with1 gm of KI and added 20 ml solvent, placed in a boiling water bath for 30 seconds. After it add 20 ml of 5% KI solution. Now titrate with N/50 sodium thiosulphate until yellow colour disappeared, 0.5 ml starch was added and continued titrate till blue colour disappear and a blank is also prepared. Peroxide value measured using formula-

Peroxide value = V X N X 1000/Sample (gm).

Where, V = $Na_2S_2O_3$, N = Normality of $Na_2S_2O_3$.

3. RESULTS AND DISCUSSION

3.1 % Oil Content

The result on percentage yield of oil was presented in the Table 1. With respect to oil content, genotype UG-172 (46.43%) had maximum oil content, followed by UG-174 (46.33%) whereas the genotype UG-184 (41.83%) had minimum oil content. The overall mean for oil content was 44.13%. Similar results obtain by Kalia et al. [5], Shad et al. [6] in different groundnut genotypes.

3.2 Saponification Value

Saponification is the process in which refluxing of oil with alkali hydrolyzes the glyceryl ester bonds to give glycerol and potassium salt of fatty acid. It indicates the nature of the fatty acid in the fats, longer the carbon chain, less acid is liberated per gram of fat hydrolyzed. Genotypes UG168 showed maximum saponification i.e. 216 mg/gm followed by GG7 i.e. 215.23 mg/gm. Minimum saponification was shown by UG181 (00145.32 mg/gm). The saponification value is only of interest if the oil is going to be used for industrial purposes as it has no nutritional significance [7].

3.3 Iodine Value

Iodine value is the measure of the degree of unsaturation in oil. It is constant for particular fat and oil. It is the measurement for quality of oil, higher the degree of unsaturation, higher the frequency of oil to go rancid. Maximum iodine value found to be 91.21 and 90.20 in genotype UG181 and UG 172 respectively amongst 24 genotypes of groundnut. Minimum Iodine value observed in genotype UG162 (55.90) (graph 3.3), similar work has been done by Eshun et al. [8] found the proximate nutrients, calorific value, mineral nutrients and lipid characteristics of the seed pastes of four (4) groundnut (*A. hypogaea* L.) varieties.

3.4 Acid Value

Free fatty acid value used as a measure of oil deterioration. According to Bassir [9], it is desirable that the free fatty acid content for a dietary lipid should lie within the limits of 0.0 to 3.0%. The acid values are lower than 1% in all cases of the oils investigated. Acid value observed maximum in genotype UG165 0.698 mg/gm and minimum acid value observed in genotype UG160 0.060 mg/gm.

Table 1. Mean performance of different genotypes for various characters in *Arachis hypogaea* L.

S. no.	Genotype	Saponificatio value	Acid value	Iodine value	Peroxide value	% oil content
1	UG158	201.97	0.463	61.00	27.50	43.60
2	UG160	184.67	0.034	65.00	9.30	44.20
3	UG161	190.24	0.204	67.30	15.00	44.63
4	UG162	188.03	0.340	55.90	26.96	45.23
5	UG163	191.67	0.250	87.60	45.60	42.63
6	UG164	195.31	0.540	69.00	16.50	43.73
7	UG165	181.33	0.698	79.10	25.00	42.63
8	UG167	209.69	0.321	86.93	31.89	42.43
9	UG168	216.11	0.110	80.37	23.23	43.67
10	UG169	212.33	0.169	86.61	15.00	44.90
11	UG170	199.11	0.216	75.31	18.90	44.63
12	UG172	209.23	0.039	90.20	23.20	46.43
13	UG173	198.61	0.079	63.21	25.60	45.23
14	UG174	187.32	0.329	67.71	11.23	46.33
15	UG175	189.88	0.189	58.20	17.50	44.63
16	UG177	177.33	0.091	85.30	11.88	42.43
17	UG178	203.50	0.361	69.21	14.28	42.33
18	UG179	189.88	0.455	59.11	19.30	45.67
19	UG181	145.32	0.513	91.21	25.23	44.73
20	UG182	204.40	0.891	88.20	19.90	46.00
21	UG184	169.17	0.362	69.33	16.23	41.83
22	PM2	183.11	0.184	85.21	13.84	44.20
23	UG5	205.33	0.235	77.23	15.66	42.70
24	GG7	215.23	0.532	71.23	16.23	44.47

3.5 Peroxide Value

Peroxide value is a biochemical characterization for quality of oil. In oxidative rancidity oxygen is taken up by fat with formation of peroxide. Peroxide value found to be maximum for genotype UG163 45.60 millieqivalent peroxide / kg per sample followed by minimum peroxide value in genotype UG160 9.30 millieqivalent peroxide / kg per sample.

4. CONCLUSION

The study has established the biochemical characterization value of the groundnut seeds which could be considered as good sources for quality determination of oil. The study also identified groundnut varieties with various quality attributes which could be used by manufacturers of groundnut products to select the varieties with desirable quality attributes for their products. For soap-making, it will be beneficial to use the oil from GG7 because of its high saponification number. The studied chemical properties of the groundnut oils indicated that the oils have potential for development for use as domestic and industrial oils. The oils are non-drying and this qualifies them to be used in the paint industry. The large saponification [10] values obtained indicate that the oils will be useful in the soap industries and in the manu-facture of lather shave creams. Among all 24 genotypes of groundnut UG175 found as superior genotype for all the aspect of oil quality and can be used in breeding program.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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