Al-Qadisiyah Journal For Agriculture Sciences (QJAS)
ISSN : 2618-1479 Vol.12, Issue. 2 ,(2022), pp. 41-48
https://jouagr.qu.edu.iq/

Physiochemical Properties Characterization of Local Sesame Seeds (Sesamum indicum L.) Grown in Kurdistan Region

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Received : 11/7/2022
Acceptance : 26/7/2022
Available online: 30/12/2022

Abstract. The aim of this investigation to determine the physical and chemical properties of three sesame seeds sample to see the differences between mixed and the sieved sesame seed and which one is better and which sesame seed has the best physical and chemical properties: which were taken from sharzoor in Sulaymaniyah (S, mixed brown), Akre in Duhok (A, mixed brown) and Mala Omar in Hawler (MO, mixed brown). For each sample two parts were taken to undergoes study the first one as a mix and other part was sieved in three different mesh size sieve (1.50, 1.35, 1) mm, then three sieves divisions of sesame seed size were obtained, Large (L), Medium (Med), Small (Sm) and the three dimension of all sesame seeds parts were measured by applying Digital Dial Caliper instrument. The dimensions length (L,mm), width(W,mm) and Thickness(T,mm) were measured for determine of geometrical properties of sesame seeds sample and all samples color was as a mix of brown color such as volume (V, mm^3), sphericity (S, %,), arithmetic diameter (Da, mm), geometric diameter (Dg, mm), apparent density (ρd, kg/m3), transverse surface area (At, mm2) and flat surface area (Af, mm2) also weight of 100 seeds (g) was estimated. The result of the study indicated that Akre (A) sesame seed sample length for mix and med has higher value 3.33 and 3.08 mm respectively. The Mala Omar sample width for all mix and other parts large, small reported higher measurement 1.75, 1.86, 1.27mm respectively. The thickness of the mix and large parts of Sharazoor reported higher measurement 0.90 and 0.91 mm while. Mala Omar Sample C3 of sesame seed scored highest moisture content 4.909%, while Akre sample B1 recorded the lowest moisture content. The large part of S, A and MO sesame seed samples firstly with higher fiber content 16.141, 17.56, 18.34 respectively.

Keywords. Local sesame seeds, Physiochemical Properties, Sieving size, Digital dial calliper.

1. Introduction

Sesame (Sesamum indicum L.), a member of the Pedaliaceae family, is an erect annual herb commonly known as sesamum, benniseed, or simsim. It is one of the oldest and most traditional oilseed crops, valued for its high-quality seed oil [1]. Sesame seed provides nutritious protein, highly stable oil, and meals, is used in confectionery foods, and possesses varieties of therapeutic medicinal properties. [2]. Sesame seed is the most significant economic material for oil production in the globe, and it also contains other nutrients like protein, calcium, and phosphor. Due to export and manufacturing economy, this seed plays an essential role in the normal providence. Sesame seeds are

DOI: 10.33794/qjas.2022.134829.1063

often produced as a double crop for oil production. Sesame farmed area in Egyptian was around 70426 fedans every year [3].

Sesame seeds' geometrical qualities are crucial in challenges including sieve unit designing and development, a specific machine, handling, cleaning, and storage. Sesame seeds oil is used as a cuisine oil and as a raw ingredient in the manufacturing of paints, butter, and varnishes, among other things. Its protein has a high-quality amino-acid composition and is nutritionally equivalent to that of soya beans [4].

Many problems involving the creation or advancement of a machine, the analysis of the product's behavior in handling of materials, directly affecting with in substance under load, electrolytic isolation of seed, lamp refraction, and color evaluation rely on geometrical properties of the material such as form, length, quantity, and size distribution. [5]. The form of the materials is an essential design component in moving solid materials by air or water [6].

The key elements that influenced separation efficiency were sieving duration, cell shape, and oscillation speed. Increased sieving times and oscillation speed rotation per minute (rpm) improved efficiency. The goal of this research was to determine the geometrical qualities of sesame seeds which the results are agreement with [7] and how they affect the design and development of precision planting, cleaning, separation handling systems, storage, and threshing equipment [8].

2. Materials and Methods

2.1. Sample Preparation

The samples of sesame seeds which are used in the study was obtained from a farm in sharzoor in Sulaymaniyah (S), Akre in Duhok (A) and Mala Omar from Erbil (MO). Foreign matter such as stones, dirt, and broken seeds were manually removed from the sesame seeds.

2.2. Sesame Seeds Used in Studies

400 sesame seeds were taken randomly for each sesame seeds sample (S, A and MO). 100 seeds for mix part and 300 seeds after sieving in three sieves which have 1.5, 1.35 and 1 mesh according to their pore volume from greater to smaller, from this process three different volume of subdivision or pats of sesame seed samples were obtained that is:

1.5 mesh is the large part (L)
1.35 mesh medium part (M)
1 mesh for small (Sm) part

2.3. Instrumentation

Dimensions (Length, width, and thickness) were measured for sesame seed samples through applying a Toolzone 150 mm Electronic Digital Vernier Caliper TC- 000899, X0005RMBUD in which reading up to 150 mm and its accuracy 150 mm.

For weighing sesame seed samples METTLER TOLEDO an electronic balance (Switzerland) was used, SNR 1118151898, TDNR 26215122

2.4. Physical Properties of Sesame Seeds

The sesame seed dimensions for samples like (L,mm), (W,mm), and (T,mm) were measured then the geometrical properties for sesame seeds such as (v, ⟦mm⟧^3), (Da, mm), (Dg, mm), (S, %), (ρ_d, kg/m^3) ,(At,⟦mm⟧^2), (Af, ⟦mm⟧^2) are determined and weigh of 100 seeds for each sample was taken.

For calculating mentioned geometrical properties for sesame seeds samples the following relationships are used [9].

$$Dg = (L \times W \times T)1/3 \quad (1)$$

$$Da = ((L+W+T))/3 \quad (2)$$

$$S= \ ((L\times W\times T)1/3)/L \ \times 100 \quad (3)$$

$$V= \pi/6(L\times W\times T) \quad (4)$$

The seed surface area, which includes the (At) and (Af), is calculated in ⟦mm⟧^2 based on the measure dimension [6].

$$At = \ \pi/4 \ (W\times T) \quad (5)$$

$$Af = \ \pi/4 \ (L\times W) \quad (6)$$

Apparent density of seed (ρd): It was calculated for the sesame seeds by dividing the weight of a quantity of sesame seeds on its volume.

$$\rho d = \ Wb/Vb \quad (7)$$

Where:-
ρd: Apparent Density of seeds, kg/m3,
Wb: Weight of sesame seeds sample, kg and,
Vb: Volume of sesame seeds, m3.
The weight of 100 seeds was weighing by an Electronic balance.

2.5. Moisture Content

1g of sesame seeds of each sample (A-C3) placed in dried weighted dish then dried in an oven at 105 oC for 6 hs, after cooling in desicator, the samples were weighted to a constant value. Then moisture content calculated by using the equation below [10]

Moisture content %= (wt .of Sesame Seed sample – wt . of the dried sample)/(wt .of Sesame Seed sample)×100

2.6. Ash Content

In a weighted porcelain crucible 1g finely grounded sesame seeds of each sample (A - C3) was ignited and heated in muffle furnace to 550 oC for 12 hs until gray white color was obtained, after cooling in desiccator, the samples were weighted. Three replicates for each sample were taken. Then percentage of ash content was calculated for each sample via the following equation [10].

2.7. Crude Fiber

2g from each crushed sesame seeds sample (A1- C3) and mixture sample (A-C) was placed in a small round bottom flask, then add 100 ml of 0.128 M sulpheric acid solution and boiled under reflux to 100 oC after heating the temperature lowerd to 80 oC for 40 min. The hot solution was filtered, the residue washed with distilled water, and after the distilled water removed add 100 ml from 0.223 M potassium hydroxide boiled under reflux for 40 min and filtered. After washing the residue with boiling water and drying to constant weight W1 in an oven at 100 oC after first weighting add to muffle furnace at 550 oC for after cooling reweighted W2, Three replicate from each sample were conducted. Crude fiber calculated by using the below equation [11].

Crude fiber % = (W1-W2)/(Weight of original sample) ×100

Where: W1= sample weight after placing in an oven.
W2= sample weight after placing in the furnace.

DOI: 10.33794/qjas.2022.134829.1063

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3. Results and Discussion

3.1. Physical Properties of Sesame Seeds

The measurements and results of the L, W, T, weight of 100 seeds, V, Da, Dg, S, ρ_d, At, Af, for S, A, and H sesame seeds samples that divided by sieving to large, medium, small are shown in table 1,2,3.

These geometrical properties can be useful in the development or production of equipment and their activities, as well as in the analysis of product behavior during handling and sieving processes.

Figure 1 indicated that Akre (A) sesame seed sample length for mix and med has higher value 3.33 and 3.08 mm respectively while for Mala Omar (MO) sesame seed sample length shows higher value for both large and small size 3.33 and 2.98 mm respectively than other sample.

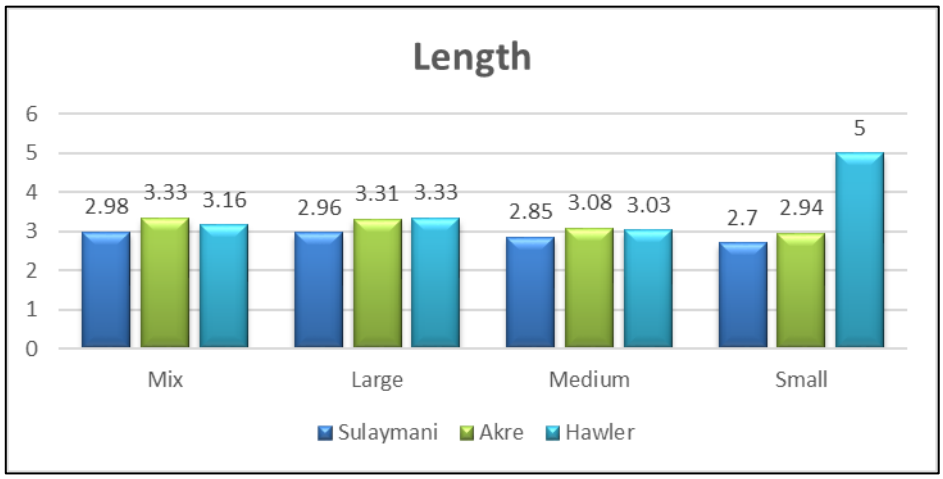

Figure 1. Length dimension of Mix, Large, Medium and Small parts of sesame seed samples (Sharazoor, Akre, Mala Omar).

Table 1. Physical properties of Mix, L,Med and Sm size for Sharazoor sesame seeds sample by SPSS program.

Seed parameter of 100 seeds	Mean ± S.D			
	Mix	L. part	M. $_{part}$	S. $_{part}$
L, mm	2.98 ± 0.07759	2.96±0.07228	2.853±0.0645	2.70 ±0.0667
W, mm	1.62 ± 0.03936	1.60±0.02337	1.43±0.0117	1.27±0.0194
T, mm	0.90± 0.02335	0.91±0.04725	0.70±0.01789	0.69±0.0459
D_g, mm	1.63 ± 0.0214	1.62 ±0.0267	1.42±0.0174	1.33±0.03320
D_a, mm	1.76 ±0.0529	1.81±0.0254	1.66±0.0235	1.55±0.0276
S, %	52.68 ±1.8021	54.92±1.1484	50.86±1.1694	49.42±1.4012
V, mm^3	2.27 ± 0.0858	2.24±0.1190	1.49±0.0569	1.24±0.0977
A_t, mm^2	1.14 ±0.0401	1.135 ±0.052	0.78±0.0184	0.69±0.0499
A_f, mm^2	3.80 ±0.1351	3.707±.1056	3.19±0.0715	2.68±0.0661
ρ_d, kg/m3	0.72 ±0.02293	0.73±0.0341	0.96±0.0347	1.06±0.0666
mass of 100- seeds, g	0.280	0.282	0.200	0.130

Table 2. Physical properties of Mix, L, Med and Sm size for Akre sesame seeds sample by SPSS program.

Seed parameter of 100 seeds	Mean ± S.D			
	Mix	**L. part**	**M. part**	**S. part**
L, mm	3.33 ± 0.0792	3.31±0.0536	3.08±0.0777	2.94±0.0769
W, mm	1.74 ± 0.0490	1.74±0.0344	1.43±0.0344	1.24±0.0284
T, mm	0.89± 0.0261	0.91±0.0294	0.88±0.0294	0.73±0.0435
D_g, mm	1.73 ± 0.0332	1.73 ± 0.0308	1.56 ± 0.0308	1.38±0.0384
D_a, mm	1.99 ±0.0361	1.99 ±0.0311	1.80 ±0.0311	1.64±0.0378
S, %	52.02 ±1.0358	52.42 ±0.4754	50.89 ±0.4754	46.78±0.811
V, mm^3	2.72 ± 0.1482	2.76 ± 0.1410	2.04 ± 0.66	1.40±0.1170
A_t, mm^2	1.22 ±0.0551	1.25 ±0.0489	0.99 ±0.077	0.71±0.0457
A_f, mm^2	4.54 ±0.1683	4.53 ±0.1279	4.46 ±1.1253	2.87±0.096
ρ_d, kg/m3	0.65 ±0.0301	0.64 ±0.0300	0.75±0.065	0.94±0.0756
mass of 100- seeds, g	0.312	0.331	0.201	0.128

Table 3. Physical properties of Mix, L, Med and Sm size for Mala Omar sesame seeds sample by SPSS program.

Seed parameter of 100 seeds	Mean ± S.D			
	Mix	**L. part**	**M. part**	**S. part**
L, mm	3.16 ± 0.0816	3.33±0.0629	536±0.033.0	2.98±0.0513
W, mm	1.75 ± 0.0370	1.86±0.0359	1541.43±0.0	1.27±0.0175
T, mm	0.84± 0.0303	0.84±0.0325	3868±0.070.	0.71±0.0532
D_g, mm	1.66 ± 0.0390	1.73 ± 0.0308	299 ± 0.0491.	1.38±0.0392
D_a, mm	1.91 ±0.0438	1.99 ± 0.0337	267 ±0.0741.	1.65±0.0315
S, %	52.65 ±1.6660	52.29 ±0.7780	.32 ±0.809449	46.52±1.0161
V, mm^3	2.44 ± 0.1632	2.71 ± 0.1507	1.76 ± 0.1023	1.42±0.1202
A_t, mm^2	1.15 ±0.0557	563 ±0.031.2	0.87 ±0.0429	0.71±0.0540
A_f, mm^2	4.34 ±0.1946	601 ±0.1814.	3.39 ±0.0831	2.97±0.0790
ρ_d, kg/m3	0.74 ±0.0460	62 ±0.03700.	0.84±0.0540	0.95±0.0757
mass of 100- seeds, g	0.309	0.317	0.202	0.119

The MO sample width for all mix and other parts large, small reported higher measurement 1.75, 1.86, 1.27mm respectively than others only medium for all samples have the same value.

Table 1,2,3 shown the The thickness of the mix and large parts of S reported higher measurement 0.90 and 0.91 mm while, sample MO and A approximately the same but thickness medium and small group of A 0.88 mm and 0.73 mm showed higher value than other sample sesame seeds as shown in figure 3 which agree with [10].

It was found A and MO sample shows the same value for Dg property in part C1, B1 1.73 mm and C2, B2 1.38 mm also sample A shows higher value for B part Dg 1.73

For arithmetical diameter the mix, large and med part of A reported higher measurement 1.99 mm, 1.99 mm, 1.80 mm, than sample MO and S sample but the small part of MO sample seed 1.65 mm showed higher than A and S.

DOI: 10.33794/qjas.2022.134829.1063

It was indicated that S% of S sample in both large part, and mix 54.92%, 52.68, higher than A and MO. While for med and small 50.89, 46.78% reported group A the other are lower.
The volume of A sample sesame seed reported higher value than S and MO sample for B, B1 and B2 2.72, 2.76 and 2.04 mm respectively, while larger volume sesame seed was calculated for MO small part (C3) 1.52 mm3
But according to the transverse surface area the higher value for mix, large, med and small part is determined for A sample 1.22, 1.25, 0.99, 0.71 mm respectively.
It was found that S sample seeds, its flat surface area (Af) showed lowest value for (A-A3) part compering with the A and MO sample seeds, while A sesame seed sample has higher Af value for B and B2 part then MO sample.
The MO sample bulk density for mix 0.74 mm is higher than others while S sample sesame seed, large, med and small part reported higher 0.73, 0.96, 1.066mm respectively than others its agreement to [12].

3.2. Moisture Content

Moisture content of sesame seed samples (A-C3) was significantly different among themselves and the result are shown in Figure 2. Sample C3 of sesame seed scored highest moisture content 4.909%, while sample B1 recorded the lowest moisture content. Moisture content in A3, B3, C3 is highest firstly than their other parts of sesame seed A-A2, B-B2, C-C2 and secondly in the mixed part A,B,C for the sample S, A and MO higher than other parts. This results are agreement with [13] who reported the range of sesame seed moisture content from 2.7% - 4.7%.

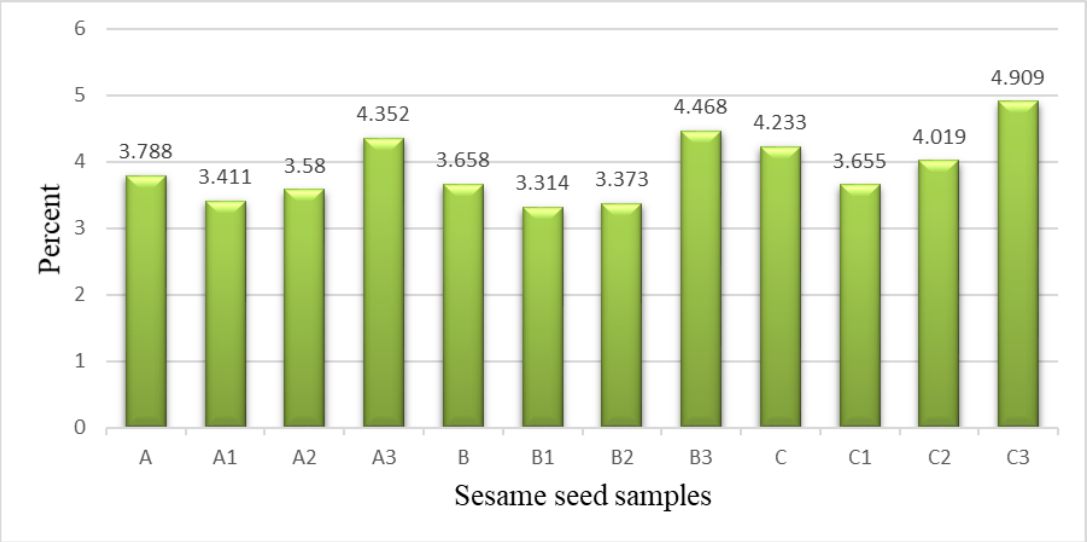

Figure 2. Moisture content in sesame seed for the parts (A-C3) of S, A and MO samples.

3.3. Ash Content

A1 sesame seed Sample scored highest ash content 12.846%, while MO C3 sample recorded the lowest ash content 1.717%. These results are agreement with [14] who reported the range of sesame seed ash content from 4.46 g/100g- 6.19 g/100g.

3.4. Fiber content

There is a significant differences in the amount of crude fiber in sesame seed sample parts (A-C3). C1 part of MO sample has a higher percent of crude fiber 18.340 %, while sample A3 has a lower percent of crude fiber 7.413%. As a general from this work it was found that the large part of S, A and MO sesame seed samples firstly with higher fiber content 16.141, 17.56, 18.34 respectively, secondly the

mixed part. It has been found that crude fiber for sesame seed is between 3.2% - 10.0% reported by [15].

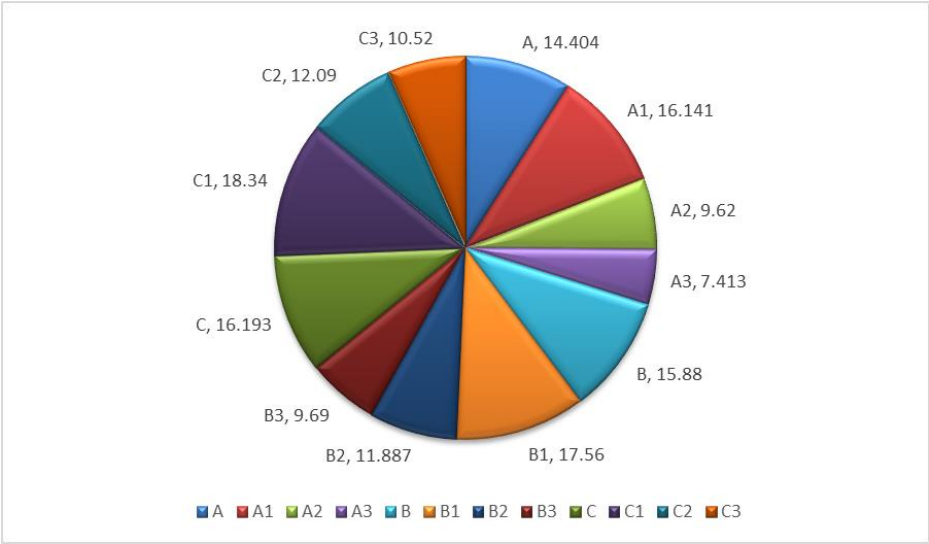

Figure 3. Crude fiber in sesame seed for the parts (A-C3) of S, A and MO samples.

Conclusions

Length seeds of mixed sesame seeds has higher value while length of small has lower value, The L and Dg all parts sharazoor sample has a lower value, Sharazoor mix A sample has higher value for Dg B part, A higher in geometrical diameter also A sample with higher value of At in mix, large and midium part, Sharazoor sample seed showed lowest value for Af than other samples Akre and Mala Omar. The moisture content on db will be higher in small parts then in mixed. The amount of ash content in sharazoor sample is approximately highest than other sample. Has good nutritional value based on material content. The local mentioned samples nearly higher fiber content so its good healthy fiber source.

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DOI: 10.33794/qjas.2022.134829.1063

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DOI: 10.33794/qjas.2022.134829.1063