Study the morphological and optical properties for nanoparticle Sesame by Vibra-Cell Ultrasonic Liquid Processors

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Abstract. Sesame is a plant that possesses many features that go into food, industry and medicine applications, the main objective of the research is to convert the sesame into nano particles using Vibra-Cell Ultrasonic Liquid Processors device. X-ray diffraction was used to ensure that the material does not change in its component, scanning probe microscope SPM was employed to ensure that the sesame is converted to nano particles, and Ultraviolet-visible Spectroscopy was utilized to diagnose of the formed nanomaterial, since the structure and environment of the light absorbing species for the sesame and the nano ‘sesame effect the particular frequencies

Keyword: Nano-particles, Sesame plant, Ultraviolet-visible spectroscopy, X-ray diffraction

1. Introduction

A 100 grams of the dried whole sesame seeds provide 573 calories and consist of 3% carbohydrates (including 12% dietary fiber), 18% protein, 50% fat and 5% water. Whole sesame seeds contain big amount of dietary minerals and several vitamins, especially zinc, phosphorus, calcium, magnesium and iron (20 percent or more of the Daily Value). The by-product that remains after oil extraction from sesame seeds, also known as sesame oil meal contains high amount of protein (35-50 %) and is used as poultry and livestock feed [1,2,3]. A meta-analysis showed minor decreases in both diastolic and systolic blood pressure in the sesame intake. specialized papers an sesame oil showed a the reduce in oxidative stress markers a lipid per oxidation [4,5]. Nanotechnology is a general term relating to all nano-scale technology and research, which refers to the scientific concepts with new properties that can be discovered and perfected while working within this context. Nanotechnology operates on matter at nanometer-scale dimensions (1-100 nm) and can therefore be used for a wide variety of applications and development of various types of nano materials and nano devices. The properties change as the materials are taken down to the nano size, and nanoparticles have certain optical, magnetic or electrical properties than larger particles. There are few sectors that will avoid the nanotechnology influence [6]. Nanoemulsion term mean spoken of as a thermodynamically stable, clear solution of two non-soluble liquids, such as water and oil, stabilized by a surfactant molecular interface film. Nanoemulsions are a novel drug delivery mechanism that involves emulsified oil and water systems with a mean droplet size varying between 50 to 1000 nm. The nanoemulsions and emulsions are mainly different in the shape and size of the particles dispersed in continuous phase [7]. From an instrumentation perspective scanning probe microscope (SPM) is started utilized as quantitative measurement instruments not just for measurements but also to clarify chemical and physical properties at the form an instrumentation perspective, The SPM uses a nanoscale probe to trace the surface of the sample depending on physical interactions the signal of the interaction is recorded and is generally utilized to measure the distance between the surface of sample and the probe [8].
2. Materials and method

The Nanoemulsions of sesame prepared by using 50ml of this sesame paste, 450ml water, and Vibra-Cell Ultrasonic Liquid Processors device that fixed at 20 kHz and 750 Watt. This device is used for typical applications include nanotechnology (producing nanoparticle materials).

2.1. Preparation of sesame Nanoemulsions.
The sesame was ground well with a special mill till becomes in form of paste named sesame paste. Then 50ml of this paste was mixed with 450ml water. After that a Vibra-Cell Ultrasonic device was applied to this mixture over one hour for five consecutive days. Consequently, the nanoemulsion of sesame is produced. Whereas, this nanoemulsion was generated by vibration ultrasound with alternating high pressure that causes the liquid molecules to collapse into eventually nanoparticles.

3. Results

There are three types of analysis that was used to characterize the sesame paste and nanosesame paste properties.

3.1. X-ray diffraction (XRD).
The techniques of X-ray diffraction are based on the elastic scattering of x-rays from long range order structures. Finding the molecule’s structure or form is an effective nondestructive technique used to classify crystalline materials [9,10]. This analyze offers information on shapes, phases, desired crystal orientations (texture), and other structural parameters. For example crystalline, average grain size, crystal defects and strain. The XRD for sesame and nanosesame paste is shown in Figure 1 and Figure 2

![Figure 1. XRD plot for the sesame paste.](image-url)
3.2. Scanning probe microscope.
Scanning probe microscopy (SPM) is one of the significant and effective apparatus in modern nanoscale research that enables high-spatial resolution investigation of the morphology and local properties of solid body surfaces [11]. It was used to analyze the characterization of the particles of sesame paste and the nanoparticles of sesame paste. The average diameter of resultant particles and its properties are listed in the table 1 and table 2. The result shows that the average diameter of the sesame is 90.46 nm and that 10% of the diameter is less than 70.00 nm and 50% of the diameter is less than 85.00 nm and 90% is less than 110.00 (see Table 1). Table (2) the accumulation, distribution, and volume of particles of sesame paste, and Table 3 Surface Roughness parameters for the sesame paste particles. Figure 3 illustrates the granularity accumulation distribution of the particles, Figure 4 represents the distribution and homogeneity structure of particles and Figure 5 illustrates the distribution of particles and shows that the particle size according to the color (black to white).

| Diameter(nm) | Volume(%) | Cumulation(%) |
|-------------|-----------|---------------|
| 70.00       | 2.72      | 2.72          |
| 75.00       | 14.67     | 17.39         |
| 80.00       | 13.04     | 30.43         |
| 85.00       | 8.70      | 39.13         |
| 90.00       | 15.22     | 54.35         |
| 95.00       | 10.33     | 64.67         |
| 100.00      | 10.33     | 75.00         |
| 105.00      | 9.24      | 84.24         |
| 110.00      | 3.26      | 87.50         |
| 115.00      | 7.07      | 94.57         |
| 120.00      | 2.72      | 97.28         |
| 125.00      | 1.09      | 98.37         |
| 130.00      | 0.54      | 98.91         |
| 135.00      | 0.54      | 99.46         |
| 165.00      | 0.54      | 100.00        |
Figure 3. The Granularity accumulation distribution of the particles

Figure 4. The distribution and the homogeneity structure of particles

Figure 5. The distribution of sesame paste particles
Table 3. Surface Roughness parameters for the sesame paste particles

| Amplitude parameters                  | Value      |
|---------------------------------------|------------|
| 1 Sa (Roughness Average)              | 4.57(nm)   |
| 2 Sq (Root Mean Square)               | 5.27(nm)   |
| 3 Ssk (Surface Skewness)             | 0.00262    |
| 4 Sku (Surface Kurtosis)             | 1.8        |
| 5 Sy (Peak-Peak)                     | 18.2(nm)   |
| 6 Sz (Ten Poi Height)                | 18.2(nm)   |

| Hybrid Parameters                    | Value      |
|--------------------------------------|------------|
| 1 Ssc (Mean Summit Curvature)        | -0.0489(1/nm) |
| 2 Sdq (Root Mean Square Slope)       | 0.6(1/nm)  |
| 3 Sdr (Surface Area Ratio)           | 14.9       |

| Functional Parameters                | Value      |
|--------------------------------------|------------|
| 1 Sbi (Surface Bearing Index)        | 5.59       |
| 2 Sci (Core Fluid Retention index)   | 1.49       |
| 3 Svi (Valley Retention index)       | 0.0685     |
| 4 spk (Reduced Summit Height)        | 2.04(nm)   |
| 5 Sk (Core Roughness Depth)          | 15.8       |
| 6 Svk (Reduced Valley Depth)         | 0.471(nm)  |
| 7 Sdc (0-5 % height intervals of Bearing Curve) | 0.944(nm) |
| 8 Sdc (5-10 % height intervals of Bearing Curve) | 0.891(nm) |
| 9 Sdc (10-50 % height intervals of Bearing Curve) | 7.34(nm)  |
| 10 Sdc (50-95 % height intervals of Bearing Curve) | 8.19(nm)  |

| Spatial Parameters                   | Value      |
|--------------------------------------|------------|
| 1 Sds (Density of Summits)           | 522(1/um2) |
| 2 Fractal dimension                  | 2.55       |

The result for sesame paste nanoparticles is shown in Table 4 the average diameter of the sesame is 56.22 nm and there is 10% of the diameter less than 0 nm and 50% of the diameter is under 50.00 nm and 90% is under 65.00 nm. Table 5 illustrates the distribution, volume and accumulation of sesame paste particle which the diameter is from (50.00-105.00) nm and Table 6 the Surface Roughness parameters for the nanosesame paste particles. Figure 6 indicated the Granularity Accumulation distribution of the nanoparticles. Figure 7 represents the distribution and homogeneity structure of nanoparticles. Figure 8 illustrates the distribution of nanoparticles and the scale from (0-8) nm illustrates that the size of particle par according to the color (black to white) is distributed.

Table 4. The diameter of the sesame paste nanoparticle

| Avg. Diameter:56.22 nm | <=10% Diameter:0 nm |
|------------------------|---------------------|
| <=50% Diameter:50.00 nm| <=90% Diameter:65.00 nm |
Table 5. The distribution, accumulation and volume of nano particles of sesame paste

| Diameter (nm) | Volume (%) | Cumulation (%) |
|--------------|------------|----------------|
| 50.00        | 17.28      | 17.28          |
| 55.00        | 39.51      | 56.79          |
| 60.00        | 23.05      | 79.84          |
| 65.00        | 8.64       | 88.48          |
| 70.00        | 4.53       | 93.00          |
| 75.00        | 3.29       | 96.30          |
| 80.00        | 2.06       | 98.35          |
| 85.00        | 0.41       | 98.77          |
| 90.00        | 0.41       | 99.18          |
| 100.00       | 0.41       | 99.59          |
| 105.00       | 0.41       | 100.00         |

Figure 6. The Granularity Accumulation distribution of the nanoparticles

Figure 7. The distribution and homogeneity structure of nano-particles.
Figure 8. The distribution of nanosesame paste particles.

Table 6. The Surface Roughness parameters for the nanosesame paste particles

| Amplitude parameters | 1   | Sa (Roughness Average) | 2.16(nm) |
|----------------------|-----|------------------------|----------|
|                      | 2   | Sq (Root Mean Square)  | 2.49(nm) |
|                      | 3   | Ssk (Surface Skewness) | 0.00261  |
|                      | 4   | Skt (Surface Kurtosis) | 1.79     |
|                      | 5   | Sy (Peak-Peak)         | 8.61(nm) |
|                      | 6   | Sz (Ten Poi Height)    | 8.59(nm) |
| Hybrid Parameters    | 1   | Ssc (Mean Summit Curvature) | -0.00936(1/nm) |
|                      | 2   | Sdq (Root Mean Square Slope) | 0.199(1/nm) |
|                      | 3   | Sdr (Surface Area Ratio) | 1.84     |
| Functional Parameters| 1   | Sbi (Surface Bearing Index) | 5.7     |
|                      | 2   | Sci (Core Fluid Retention index) | 1.5     |
|                      | 3   | Svi (Valley Retention index) | 0.0685  |
|                      | 4   | spk (Reduced Summit Height) | 0.959(nm) |
|                      | 5   | Sk (Core Roughness Depth) | 7.45(nm) |
|                      | 6   | Sv (Reduced Valley Depth) | 0.214(nm) |
|                      | 7   | Sdc (0-5% height intervals of Bearing Curve) | 0.437(nm) |
|                      | 8   | Sdc (5-10% height intervals of Bearing Curve) | 0.437(nm) |
|                      | 9   | Sdc 10-50 (10-50% height intervals of Bearing Curve) | 3.45(nm) |
|                      | 10  | Sdc 50-95 (50-95% height intervals of Bearing Curve) | 3.87(nm) |
| Spatial Parameters   | 1   | Sds (Density of Summits) | 176(1/μm²) |
|                      | 2   | Fractal Dimension       | 2.58     |
3.3. Ultraviolet-visible spectroscopy.

Valuable information about the prepared samples were collected, for example the sample purity, the light's amount absorbed and the wavelength absorbed by the sample. The light amount absorbed is related to the size of the sample, and thus quantitative analysis can be possible calculated by optical spectroscopy. The larger the number of molecules that absorb light from a given wavelength, the greater the degree of the absorption of light, and the higher the absorption spectrum peak intensity. Absorbance (A) can be measured using the Beer's and Lambert's law [12-14]:

\[-\log T = \varepsilon cl\]  \hspace{1cm} (1)
\[A = \varepsilon cl\]  \hspace{1cm} (2)
\[A = -\log T\]  \hspace{1cm} (3)

Where \(\varepsilon\): is the Molar Extinction coefficient. It is a constant for the absorbing species and defines the absorption of the species at particular wavelength. it is determined by the number and type of chromophores present in each molecule of the absorbing species.

\(c\): is the sample concentration.
\(l\): represent the length path through the sample.
\(T\): is the transmittance of light for sample [15].

The UV-Vis spectrometer was used to obtain the Absorbance spectra of sesame paste and nanosesame paste as shown in Figure 9 and Figure 10, respectively.

![UV-Vis spectrum as a wavelength function for the sesame paste.](image)

**Figure 9.** UV-Vis spectrum as a wavelength function for the sesame paste.
Figure 10. The UV-Vis spectrometer as a wavelength function for the nanoseseam paste

4. Conclusions

The surface roughness of all the amplitude parameters has become less for the nano sesame particle, the hybrid parameters for the nanoparticles are less than for sesame nanoparticle, the spatial parameters for (Density of Summits) is less for the particle than that for the nanoparticle, while for the fractal it is higher than that for the sesame particle. Hybrid Parameters and functional parameters are also less for the nanoparticle than that for the particle from the UV the surface of the nanoparticle is smoother than that for the sesame. The nano surface sesame has become smoother than the. The XRD illustrated that the sesame keeps its features and converting them to nano does not changed its features, the UV spectrometer showed that there are differences in the distribution of the particle when it converted to nano.

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