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# Study of Mucilage properties extracted from Salvia hispanica seeds by different methods

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**Abstract-** *Mucilage was extracted from Chia seeds (black and white) with various extraction methods, including freeze-drying and drying at 60$^0$C and drying at 80$^0$C using the ground and non-ground seeds. It was found that freeze-drying was the best method to extract mucilage in high quantity which was 60% for black chia seeds and 50% for white chia seeds, the affecting factors on the properties of the resulting gels were studied such as the temperature where there was no significant change in the properties of the gel or the nature of the composition, but prefer to extract the gel at room temperature on the rest of other thermal degrees in terms of ease of separation mucilage and ease of dealing with at 25$^0$C. The best pH for the extraction was 7, while pH 8 increases the viscosity of the gel but effects on its color while pH 4 did not affect the color of the gel but the viscosity is lower. In the study of the functional characteristics of the gel, such as solubility, the percentage of solubility was 98% at5g of gel for white seeds, the black seeds gave 93% solubility, while the emulsification and consistency for the black seeds gel were higher than emulsification properties of white seeds, as well as the property of foam and stability, black seeds on white have been superior in the formation of foam, and the content of proteins and carbohydrates.*

**Research paper sited from the master thesis of the first researcher.**

**Key words: *Salvia hispanica*, Mucilage, properties, Chia seeds, Freeze-drying.**

## 1.INTRODUCTION

Salvia hispanica, commonly known as Chia plant, is a plant belonging to the Lamiaceae family, an annual herbaceous plant widely cultivated in Australia, South America, Mexico [14].Chia seeds are small in size and white in size, ranging from 2-2.5mm, width 1.1-1.2mm and thickness 0.8-1mm, and are found in several colors including white, black, brown and red, but the most common ones are white and black seeds [9].When the mucilage extracted from the seed, its molecular weight is between 800-2000 KDa.It consists mainly of polysaccharide. which consist of a series of polysaccharides, Units with a high molecular weight ranging from 0.8-2 ×106 Da and that the composition of these units, which are the mucilage was described as a tetra saccharide with a series of key consists of (1 → 4) β-D-xylopyranosyl and (1 → 4) α-D- glucopyranosyl with 4-O-methyl- α-D-glucuronic acid in O-2 in the main series [15].

The Mucilage is extracted from the Chia seeds in a several ways and the extraction method used is the one that determines the functional properties of the mucilage produced in terms of its solubility and its use as an emulsifier, stabilizer and foaming agent. There are a number of factors that affect the extraction of the mucilage, the most important of which is the temperature which affects the properties of the gel and the chemical components of the gel [3]. The effect of pH depends on the concentration of the mucilage, where the viscosity of the gel increases. pH-base and decrease in pH acid [7]. The most important characteristics of high-melting vegetable jelly are attributed to the presence of a ratio or relationship between the polysaccharides and protein [11] and the emulsification properties. The mucilage are characterized by high emulsification properties and their consistency when compared with the mucilage that extracted from the flax seeds and is an auxiliary factor in the formation of foam, Foam alone but mediated by an auxiliary substance such as egg white [1]. As a result, the mucilage extracted from the chia seeds was used as a stabilizer, emulsion agent and foam co-facilitator in various food applications such as ice cream, yogurt and pastry industry [5] and [6].

## 2.Materials and method

The mucilage of Chia seeds was extracted in both white and black through several methods:

### 2.1 First extraction method

Mucilage was extracted from the Chia seeds according to the method mentioned in [4] (method of Freeze-drying) by taking a certain weight of seeds and adding distilled water to it by 1:20 and then placed on the magnetic stirrer at 45°C for 30 minutes and is left to cool slightly. The mixture is then separated by Centrifuge at 11.600 xg

acceleration for 30 min. The leachate is taken and then the Lyophilizer-76 M is pressed under 0.001 bar and stored for use.

### 2.2 Second extraction method

The method of drying was followed by the extraction of the mucilage by taking a certain weight of the seeds and adding the distilled water to it by 1: 30 (w/v). The pH of the mixture was then measured and modified by adding 0.2 molar HCL or NaOH. The mixture was then placed on a hot plate with magnetic stirrer at 50-40°C for 2 hours. The mixture was then poured into the oven and dried at 60°C for 10 hours. Dry mucilage formed by using a 40 sieve Mesh Screen-mediated rubbing scrubs are then weighed and saved for use.

### 2.3 Third extraction method

This method was applied to both chia seeds (black and white), ground and non-ground, where a certain weight of the seeds was taken, grinded and then dried and the distilled water added to it 1:20 (w/v). The mixture is placed on the magnetic stirrer at 40°C To 80°C for 10 minutes and left to cool a little and then separated by centrifugal and pour leachate in glass dishes and dried in the oven at 60°C for 4-5 hours and the same weight is also taken seeds but not milled and follow the same steps with the seeds.

### 2.4Temperature effect

The effect of the temperature on the extraction of the mucilage is estimated according to the method mentioned in [10] using three thermocouples (8, 25 and 80). The leachate is then placed in sealed containers and stored for use.

### 2.5 Effect of pH

The effect of pH according to the method mentioned in [3] was estimated by extracting the vegetable gel under acidic conditions once and under base conditions again and measured its pH, color and viscosity.

### 2.6 Solubility and Stability

The method mentioned in [4] was used to estimate solubility by taking different weights of dry mucilage (1, 3, 5 g). The solubility of Mucilage was measured by applying the following formula:

$$solubility\% = \frac{wi - wf}{wi} \times 100$$

Where wi = initial or primary weight, Wf = final weight.

### 2.7 Emulsification and Stability

Emulsification was estimated by preparing 0.8% of the Mucilage dry mucilage of the white and black seeds after it was dissolved in 100 mL distilled water of pH = 7 as indicated in [9].The absorptivity of the samples was measured by a spectrophotometer and along 500 nm wavelength. During the application of the following equation:

$$Ep = \frac{2 \times 2.303 \times A500 \times L \times c}{\emptyset}$$

Where: C = weight of the sample, L = the length of the cell through which optical radiation passes, A500 = Model absorption at wavelength of 500 nm, Ø = size of sunflower oil.

### 2.8 Foam Determination and Stability

The foaming properties of the mucilage were estimated by preparing solutions (1, 3 and 5%) w/ v of Mucilage and attended 5% Ovalbumin solution by melting 5 g in 100 ml distilled water and wiping the solutions in an electric mixer for 10 minutes at room temperature The size of the foam formed by the following equation:

$$\%Overrum = \frac{(weight\ of\ 100\ ml\ dispersion - weight\ of\ 100ml\ foam}{weight\ of\ 100ml\ foam} X\ 100$$

## 3. Results and discussion

Extraction of Mucilage from the Chia seeds (white and black) with multiple extraction methods is of great importance in determining the optimal method for extracting the mucilage and adopting it in subsequent laboratory tests. It is noted in Table (1) that the best method for extracting the mucilage and obtaining the largest possible amount of mucilage from the black and white Chia seeds is the method of harvesting, where the percentage of mucilage extracted (50,60%),Percentage of mucilage extracted from white and black chia seeds in the second and third method (7.5,10)%, (22.5,25%), respectively. This is consistent with according [5]. It is noted that the effect of the rubbing process in the amount of gels obtained, as it was observed that there is a significant loss of the amount of gums during the process of scrub [9].It is noted in Figure (1) a larger

image of the mucilage extracted in the first method under the electronic microscope, where it is noted that the shape of the mucilage is in the form of Films, which have a large role in the use of the preparation Edible films [12] Use Mucilage Vinegar in preparing those wrappers and use them in the preservation of various food products.

**Table-1:** Percentage of mucilage extracted from white and black Chia seeds by multiple extraction methods

| Extraction methods | %Mucilage extracted from white Chia seeds | %Mucilage extracted from black Chia seeds |
|---|---|---|
| The first method | **50** | **60** |
| The Second method | **7.5** | **10** |
| The third method (ground seeds) | **12.5** | **15** |
| The third method (not grounded) | **22.5** | **25** |

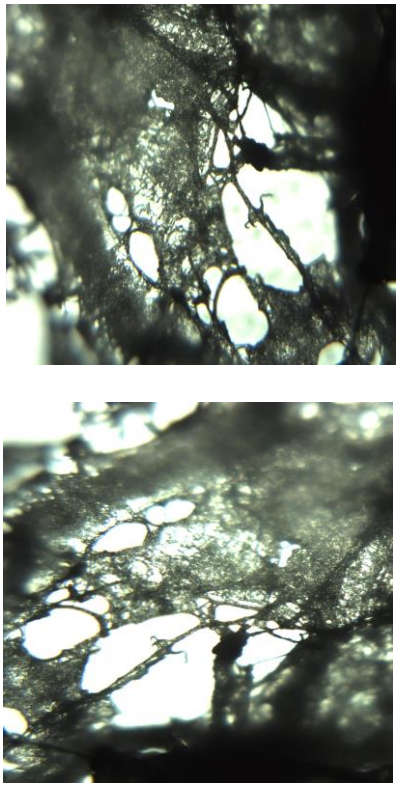

**Figure -1:** larger image of the Mucilage under the electron microscope and intensively enlarge 40X

As for the factors affecting the extraction of Mucilage Mucilage of white and black chia seeds, including temperature, it was observed that when extracting the mucilage from the Chia seeds in three different temperature degrees (8, 25, 80C) there was no significant change in the properties of the mucilage or the nature of composition, It is preferable to extract the mucilage at room temperature at the rest of the other thermal grades in terms of the ease of separating the mucilage produced by the seeds by centrifugation and easy to deal with the mucilage at a temperature of $25^0$C. This is inconsistent with what [13] said that the mucilage is better extracted in a low concentration of salt and at a temperature approaching 80°C. For pH, the effect of pH on the extraction of vegetable jelly from the black and white chia seeds was observed in Table (2).There was a noticeable change in the color of the mucilage of the two types of seeds when extracted at pH 8 and the change in the viscosity of the mucilage was the viscosity of the mucilage of the two types of seeds = 8 higher than the viscosity of the phytoplankton at pH = 4. This difference is due to the effect of mucilage when extracted under acidic conditions and basal conditions again [3, 10]. That the extraction of mucilage in the number of hydrogen is about 9 leads to an increase of his wife as a result of an overlap between the ions of the solution added to the mucilage at the extraction (Phosphate buffer) causing the increase of his wife. It is noted that the extraction of vegetable jelly with the addition of distilled water of pH = 7 is better in terms of ease of separation by centrifugation.

**Table-2:** Factors affecting the extraction of mucilage from white and black chia seeds

| Factors effacing | The Mucilage extracted from white Chia seeds | The Mucilage extracted from black Chia seeds |
|---|---|---|
| temperature | Easy to separate at 25 $^0$C | Easy to separate at 25 $^0$C |
| pH=4 | **4.1** | **4.2** |
| pH=8 | **8.2** | **8.1** |
| pH=7 | **7.1** | **7.1** |
| The viscosity of the mucilage at pH =4 | $5.3\times10^{-4}$ | $5.7\times10^{-4}$ |
| The viscosity of the mucilage at pH =8 | $9.6\times10^{-4}$ | $9.8\times10^{-4}$ |
| The viscosity of the mucilage at pH =7 | $9.2\times10^{-4}$ | $9.76\times10^{-4}$ |

As for the properties of the mucilage, Table (3) shows the percentage of mucilage extracted from white and black chia seeds and the three percentages of mucilages (1,3,5 g) respectively, dissolved in 30 ml distilled water. Jelly has a high solubility of up to 95.98% when the amount of gel used is 5 g. And the solubility of mucilage extracted from the seeds of white chia was higher when compared with the solubility of the mucilage extracted from the black chia seeds and in the same concentrations due to the difference in the type of seeds extracted from the gels and the results obtained were consistent with what [15] Indicates that the plant jelly has a high solubility and has taken advantage of this characteristic of gel In its use in the preparation of edible casings due to the high melting of mucilage and its ease of integration with the ingredients used in the preparation of these packaging [16].

**Table -3:** Percentage of solubility of the mucilage that extracted from both chia seeds (white and black)

| Type of mucilage | % Solubility (1g mucilage) | % Solubility (3g mucilage) | % Solubility (5g mucilage) |
|---|---|---|---|
| white | **80** | **90** | **98** |
| black | **80** | **87** | **93** |

Table (4) shows the emulsifying results of the mucilage extracted from white and black chia seeds.It is noted that the emulsification properties of the mucilage extracted from the white chia seeds were 40 m2 / g when the distribution ratio of the sun flower oil was 40% and 4.5m2 /g In the percentage of the distribution phase of the sun flower oil 60%. For the plant emulsification properties extracted from the black chia seeds was higher than the emulsification properties of the mucilage extracted from white chia seeds was 45 m2 / g in 40% sun flower oil and 10.6 m2 / g in 60% sunflower oil is due to the difference in these results to the type of seeds and ratios of protein in the two types of mucilage and the extent of the effect of the temperature used in the process of extracting the mucilage in the proportion of protein, which is one of the compounds of the composition of emulsification and this is pointed out [2] that the presence of protein in the jellies, mucilage Emulsification. Table (5) shows the results of the phyto-gel plant derived from the two types of chia seeds. The results show that the percentage of over run for the 1,2,3 plants in which the vegetable gels extracted from the chia seeds were used(1, 3,5% w / v) and alone without any addition of an auxiliary factor on the composition of the foam was the ratio of rent 103,111,120% and the percentage of rent for the same concentrations and the factors 1,2,3 In which the mucilage extracted from the white chia seeds was calculated by weight (1.3% w / v) and alone, without adding an auxiliary factor to the formation of the foam, the rent ratio was 103,111,120%. The rent ratio for the same concentrations and for the treatments was 1,2 ,3 But with the addition of 5% of Ovalbumin for each transaction is 502,515,580% and black 110,125,115 and 504,590,530% when adding Ovalbumin [8].

**Table -4:** Results of the emulsification properties and their persistence of plant gels extracted from both chia seeds (white, black)

| Type of mucilage | EP% (40% sunflower oil) | EP% (60% sunflower oil) |
|---|---|---|
| white | **40** | **5.4** |
| black | **45** | **10.6** |

*EP= Emulsification property

**Table -5:** Results of foam composition and composition by Mucilage, extracted from white and black chia seeds

| White mucilage treatments (without adding 5% Ovalbumin) | Over run**%** | Black mucilage treatments (without adding 5% Ovalbumin) | Over run**%** |
|---|---|---|---|
| Treatment 1 | **103** | Treatment 1 | **105** |
| Treatment2 | **111** | Treatment2 | **115** |
| Treatment3 | **120** | Treatment3 | **125** |
| White mucilage treatments (with 5% supplementation) Ovalbumin | Over run**%** | Black mucilage treatments (with 5% supplementation) Ovalbumin | Over run**%** |
| Treatment 1 | **502** | Treatment 1 | **504** |
| Treatment2 | **515** | Treatment2 | **530** |
| Treatment3 | **580** | Treatment3 | **590** |

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