

Study of the Chemical Composition and Infrared Radiation Spectrum Analysis of Plantago Seed Gum

Fatima Shafa Abbas , Wedad Fadhil Abas 

Department of Home Economics, College of Education for Women, University of Baghdad

ABSTRACT

This study aimed to determine the chemical composition of Plantago seeds and the gum extracted from it. Protein, fat, ash, moisture, fiber, and total carbohydrates were estimated. The results indicated a high percentage of carbohydrates in the gum compared to the seeds. It reached 63.1 and 44.2%, respectively. Some major and minor mineral elements were determined and analyzed. It was found that the seeds and gum contained good levels of sodium, potassium, calcium, magnesium, and phosphorus, in addition to iron, zinc, and copper. The results of the analysis of amino acids in Plantago seeds and gum using the HPLC technique indicated that the amino acid lysine had a higher percentage than the rest of the amino acids in plantago seeds, reaching 77.8%. While, the percentage of it was 4.58% in the gum extracted from the same seeds. As for the gum, the highest percentage was recorded by acid serine, which reached 10.45 mg/100 g. The results of the analysis of monosaccharides showed a high content of the gum of monosaccharides xylose and arabinose, reaching 44.12 and 37%, respectively. The infrared spectrum of plantago seed gum was analyzed using the FTIR technique to determine the active groups.

Keywords: amino acids, FTIR, gel, monosaccharides.



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INTRODUCTION

Plantago belongs to the family Plantaginaceae. It is an annual herb. Its native habitat is the Mediterranean region, especially southern Europe, northern Africa and western Asia. It has medicinal properties Al-Jubouri (2014). Plantago is an important commercial crop grown in Pakistan, India and Iran. It is also called ayzaygul, which resembles a horse's ear. It got its name originally from western Asia. Plantago was brought to India during the Mughal Empire in the Middle Ages. The four largest states producing Plantago are Gujarat, Madhya Pradesh, Rajasthan and Haryana. India produces 98% of the world's Plantago. (Noguerol & Pagan, 2021) Shah, et al. (2020) Stated that plantago seeds contain 49% of total carbohydrates, including 25% dietary fiber, 17% protein, 3% ash, and 7% fat. Mukhtar, et al. (2017) indicated that plantago seeds contain 8.6% moisture, 21.7% protein,

6.1% fiber, 29.5% fat, and 4.5% ash. The mineral content is 572 mg calcium, 540 mg phosphorus, 264 mg magnesium, 17.8 mg sodium, and 810 mg/100 g potassium, in addition to the trace minerals copper 2.7 mg, zinc 6.2 mg, iron 9.7 mg, and manganese 8.5 mg/100g. The genus Plantago includes more than 200 species whose seeds are used for gum production. The plantago seed husk is the main product separated from the seeds. The seed coat is used to produce gum by mechanical grinding. The gum is characterized by being a fibrous, hydrophilic substance that forms a transparent, colorless gelatinous substance and is an excellent food source of both soluble and insoluble fiber (Bijkerk, et al., 2004). The gel-forming fraction consists of alkali-extractable polysaccharides, mainly arabinose and xylose, with small amounts of other sugars (Shah, et al., 2020). Plantago seeds have a long history of use as a dietary fiber supplement. Humans

have used plantago since ancient times for its medicinal properties and health benefits that have been attributed to it throughout the ages. These include relieving symptoms of constipation and mild diarrhea, improving digestion, cleansing the colon, lowering blood cholesterol, reducing the risk of heart disease, aiding in weight loss, controlling type 2 diabetes, and treating inflammatory bowel disease (ulcerative colitis) and hemorrhoids. It is further used topically to address dermatological issues and insect stings. It is used in the food and dairy sectors. It serves as a thickening agent in the formulation of many food items. It has been extensively used as a medicinal agent. Fiber derived from *Plantago* peels is extensively used as a medicinal supplement and nutritious component in processed meals to avert illnesses and ailments (Katke, et al., 2020). Khahd, et al. (2021) indicated that plantago, seeds reduce, cholesterol levels and increase the production of bile. This leads to a reduction in LDL and triglyceride levels. The seeds also contain flavonoids that prevent the formation of cancer cells. Jovanovski, et al. (2018) explained that when plantago seeds were used with a diet for three weeks or more, it reduced harmful cholesterol levels in people while increasing low-density lipoprotein cholesterol levels. Due to the importance of plantago seeds and the gum extracted from it in food and pharmaceutical applications and the lack of research on plantago seeds and gum, the study aimed to estimate the chemical composition of *Plantago* seeds and gum, determine the major and minor mineral elements, estimate the amino acids of both plantago seeds and gum, the monosaccharides, and conduct an infrared spectrum (FTIR) analysis of plantago seed gum.

MATERIALS AND METHODS

Plantago seeds: Plantago seeds were obtained from herbal shops in Baghdad, collected in August 2023, and identified in the Seed Testing and Certification Department of the Department of Life Sciences/College of Science/University of Baghdad. The *Plantago lanceolata* variety was confirmed by diagnosis and belongs to the cruciferous family Plantaginaceae. The seeds were cleaned

to remove impurities and then stored in cold conditions at 4°C, tightly sealed polyethylene bags until use.

Method of extracting gum from Plantago seeds: The gum was extracted from plantago seeds according to the method mentioned by Hosseini-Parvar, et al. (2010) Suppose the seeds were soaked in distilled water at a mixing ratio of 65:1 (w/v). The pH was adjusted to 8 using a NaOH solution (0.1 molar). The extraction process was carried out at a temperature of 70°C for 20 minutes. The mixture was mixed in an electric mixer to separate the gum material from the surface of the seeds without breaking it. The gum was separated by filtration through a clean, sieved cloth and a sedimentation and purification process was carried out according to the method mentioned by Razavi, et al. (2014). This was done by adding 96% ethanol at a ratio of 2:1 filtrate: ethanol (w/v) and leaving the mixture overnight at a temperature of 5°C. Then, the mixture was filtered through a cotton sieve to separate the gum. A small amount of distilled water was added. It was mixed using a magnetic stirrer. Dried at a temperature of 40-50°C for 24 hours. The yield of gum was 25 g. The dried gum was ground in a mill, and the powder was stored in tightly sealed containers.

Chemical composition of plantago seeds and extracted gum: The chemical composition of *Plantago* seeds and extracted gum (moisture, ash, protein, fat, carbohydrates) was estimated according to the standard methods mentioned in AOAC (1995). It was carried out in three replicates and expressed as a percentage.

Fiber estimation: The percentage of fiber was estimated as mentioned in AOAC (2008)

Estimation of some mineral elements of Plantago gum and seeds: The percentages of some major mineral elements, calcium, magnesium, sodium, potassium and phosphorus, were estimated using a flame photometer. Some minor mineral elements, including zinc, copper, iron, lead and cadmium, were also estimated using an atomic absorption device. 1 g of a sample was weighed in a ceramic bowl and burned in an incineration furnace at a temperature of 550 °C for 12 hours. After the samples cooled, the ash

was dissolved in 5 ml of hydrochloric acid at a concentration of 20%. The solution was filtered using filter papers (Whatman No. 1). It was diluted to a volume of 50 ml using distilled water according to the standard methods mentioned AOAC(2008).

Estimation of monosaccharides by high-performance liquid chromatography (HPLC):

HPLC estimated monosaccharides according to the method mentioned in Ghafor, et al.(2014).

Estimation of amino acids by high-performance liquid chromatography (HPLC): HPLC estimated the amino acids according to Ghafor, et al.(2014) for both plantago seeds and the extracted gum.

Transform infrared spectroscopy (FTIR)

The infrared spectroscopy analysis identified the functional groups of plantago seed gum followed previously and referred to before Agarwal, et al.(2018).

RESULTS AND DISCUSSION

Chemical composition of plantago seeds:

Table (1) shows the results of the chemical analysis of plantago seeds. The results included estimating the percentages of protein, fat, ash, moisture, fiber, and carbohydrates. The protein percentage was 17.1% and was consistent with what was found in Noguerrol, et al. (2021). it was (17%). It was higher than what was mentioned by Kulkarni, et al. (2016), Yu, et al. (2017) it were (0.99, 1.5%,) The protein percentage was .respectively. As for El Sheikh,(2014), it was found that the protein percentage in Plantago seeds reached 14.95%. It was less than what was found in Mukhtar, et al. (2017). which was 21.7%. The reason for the variation in protein content is due to differences in the methods used to estimate proteins, surrounding conditions, climate, and harvest season (Shaker, et al., 2014). As for the fat percentage, it reached 7.5%. These results agreed with Noguerol, et al, (2021) it was (7%). It was less than what was found by El Sheikh. (2014), which was 1.34%. The percentage of ash in the seeds was 3.1%. It was consistent with what was found by Noguerrol, et al. (2021) The percentage of ash in Plantago seeds was 3%. It also agreed with the study Qaisrani, et al. (2016) The percentage of ash in Plantago seeds was

3.85%. The percentage of ash in the study Yu, et al. (2017).was 4.07%. Mukhtar, et al. (2017) indicated that the percentage of ash was 4.5%. The variation in the plant's mineral content was due to the difference in extraction methods. The percentage of fiber in Plantago seeds was 23.1%, which is higher than what was found by Mukhtar, et al. (2017), It was 6.1%. It was close to what was found by Noguerrol, et al. (2021).which was 25%. At the same time, it was less than what was found by El Sheikh.(2014), The percentage of fiber was 26.6%. The percentage of moisture in the seeds was 5.0%. This percentage was less than what was mentioned by Mukhtar, et al. (2017) 8.6%. Table (1) also indicated that the percentage of carbohydrates in Plantago seeds reached 44.2%. It was consistent with what was found by ElSheikh, (2014), where the percentage of carbohydrates reached 45.7%. It was less than what was found by Yu, et al. (2017). where the percentage of total carbohydrates was 84.9%.

Table 1.Chemical composition of plantago seeds

component	Percentage of plantago seeds
Protein	17.1
Lipid	7.5
Ash	3.1
Moisture	5.0
Fiber	23.1
CHo	44.2

Table (2) shows the results of the chemical analysis of the extracted Plantago gum. It included estimating the percentages of protein, fat, ash, moisture, fiber, and carbohydrates. The percentage of protein in Plantago seed gum in the current study was 4.2%. This is higher than what was found by Antiogo, et al (2020). which was 1.9% in oven-dried gum. At the same time, its percentage in freeze-dried gum was 2.4%, which is higher than what was found by Niknam, et al., (2020). The percentage of protein in Plantago seed gum was 2.03%. The percentage of fat in Plantago gum was 1.5%. This is higher than what was found by Antiogo, et al (2020). Which was 0.5% in oven-dried gum. In contrast, its percentage in freeze-dried gum was 1.0%. The difference in fat percentages is due to the variation in the fat content of the plant, as well

as the extraction methods used and the differences in working conditions in terms of temperature and methods of extracting and purifying gums. The ash percentage of Plantago gum reached 9.8%. It was higher than what was reached by Antiogo, et al (2020). Its percentage reached 4.0% by drying, while its percentage reached 2.5% by freezing. As for Niknam, et al, (2020), it was found that the ash percentage in Plantago seed gum reached 3.23%. The variation in the ash percentage may be attributed to the variation in the plant's mineral content and the variation in the methods of extracting and purifying the gum. Table (2) indicates that the moisture percentage of Plantago gum reached 17.8%. This is higher than what was mentioned by Antiogo, et al (2020). Which reached 11.5% by drying, while its percentage by freezing reached 13.2%. While Niknam, et al. (2020) found that the moisture percentage reached 6.20% in Plantago seed gum. The variation in moisture percentages is due to the methods used in extracting and drying the gums. As for the fibers, their percentage in Plantago gum reached 3.6%. This is close to what was reached by Antiogo, et al (2020). The percentage by drying reached 4.1%, while the highest percentage by freezing reached 5.7%. The percentage of total carbohydrates in Plantago gum was 63.1%. This is less than what was reached by Antiogo, et al (2020). which was 89.3% by drying. It was 88.2% by freezing. Carbohydrates depend on the content of Plantago gum of proteins and fats remaining after extraction.

Table 2. Chemical composition of plantago seed gum

the components	Percentage of plantago seed gum
Protein	4.2
Lipid	1.5
Ash	9.8
Moisture	17.8
Fiber	3.6
CHO	63.1

Estimation of some mineral elements of plantago seeds and gum: Table (3) indicates the content of some mineral elements of plantago seeds and gum extracted from them. The results show that plantago seeds and gum

contain a group of major and minor mineral elements. The major elements include (sodium, potassium, calcium, magnesium and phosphorus). The minor elements include (iron, zinc and copper). Their increase is noted in Plantago seeds, while their decrease in the gum extracted from the same seeds. The percentage of both sodium and potassium in Plantago seeds reached 214.5 and 695.0 mg/100 g, respectively. In contrast, their percentage decreased in the gum extracted from it to 41.5 and 22.0 mg/100 g, respectively. Mukhtar, et al. (2017) indicated that the percentage of both sodium and potassium in Plantago seeds decreased. The percentage of sodium reached 17.5 mg/100 g. The percentage of potassium reached 810 mg/100 g, while the percentage of potassium reached 0.39 mg/100g (Guo, et al., 2008), Kulkarni, et al. (2016). reported that the percentage of sodium and potassium in Plantago seeds reached 640 and 8500 mg/100 g, respectively. As for Chon, et al. (2019), it was found that the percentage of sodium reached 62.3 mg/100 g and potassium 806 mg/100 g. The percentage of calcium in Plantago seeds reached 650.8 mg/100 g, while its percentage in the gum extracted from it reached 20.5 mg/100 g of seeds and gum. This is less than what was found by Mukhtar, et al. (2017), as it reached 572 mg/100 g, and higher than Chon, et al. (2019), as the percentage of calcium in the seeds reached 1500 mg/100 g. The percentage of magnesium and phosphorus in Plantago seeds reached 133.5 and 174.0 mg/100 gm, respectively. This is higher than their presence in the gum extracted from Plantago seeds, 30.5 and 44.1 mg/100 gm, respectively. It is less than what was found by Mukhtar, et al. (2017). The percentage of magnesium and phosphorus in Plantago seeds was 264 and 540 mg/100 gm. While Kulkarni, et al. (2016) mentioned that the percentage of phosphorus in plantago seeds was 0.24%. As for Chon, et al. (2019), he indicated that the percentage of magnesium in Plantago seeds reached 19.7 mg/100 gm. The results of the current study were somewhat close to the study Guo, et al. (2008). The percentage of magnesium and phosphorus was 150 and 140 mg/100 gm, respectively. Table

(3) shows the percentage of trace minerals in plantago seeds and the gum extracted from the seeds, including (iron, zinc and copper). These elements are present in the plant and their percentage may sometimes increase due to soil pollution. Their sources are soil, water and air. The percentages of iron, zinc and copper in Plantago seeds were 51.4, 204.8 and 24.1 mg/100 g. In contrast, their content decreased in the gum extracted from the same seeds. They were 12.0, 32.4 and 1.5 mg/100 g, respectively. Mukhtar, et al. (2017) mentioned that the percentage of iron, zinc and copper was 9.7, 6.2 and 2.7 mg/100 g, respectively. The human body needs a small amount of iron.

The reason is that it is one of the essential elements for the work of a number of enzymes, such as catalase and peroxidase. It is also one of the basic elements of haemoglobin. It helps in transporting oxygen to the body's organs and forming haemoglobin. It is a protein in blood cells that plays an important role in the oxidation processes of proteins, fats and carbohydrates. While zinc helps control diabetes, it is necessary for the production of insulin in the body. As for copper, it is one of the basic mineral elements for living organisms and is involved in the composition of the enzymes cytochrome oxidase and other enzymes (Oku & Morah, 2004).

Table 3. Analysis of some mineral elements of plantago seeds and the gum extracted from it, mg/100 gm

Mineral element	Plantago seeds	Plantago seed gum
	Major Minerals	
Sodium(Na)	214.5	41.5
Potassium(K)	695.0	22.0
Calcium(Ca)	650.8	20.5
Magnesium(Mg)	133.5	30.5
Phosphorus(P)	174.0	44.1
	Minor minerals	
Iron(Fe)	51.4	12.0
zinc(Zn)	204.8	32.4
Copper(Cu)	24.1	1.5

Analysis of monosaccharides of plantago seed gum: Table (4) shows the results of the separation and the identification of monosaccharides of plantago seed gum using HPLC technique. The results show that Plantago gum contains monosaccharides, which are glucose, fructose, maltose, xylose, mannose and arabinose. The results showed that plantago gum contained a high percentage of xylose and arabinose. It reached 44.12 and 37% respectively. In comparison, the percentage of fructose in plantago gum was 4.2%. In contrast, the content of each glucose and mannose was 7.3 and 6.2%, respectively. Arshad, et al. (2022) mentioned that apinoxylan extracted from Plantago peels contained monosaccharides, which are arabinose 13.38%, xylose 64.23%, glucose 1.89%, galactose 3.64% and rhamnose 1.43%. Verma, et al. (2013) indicated that plantago seeds contained monosaccharides, the highest percentage of which was xylose, which reached 56.72%, while rabinose reached 21.96. At the same time, the percentages of

rhamnose, galactose, glucosomannose, and arabinoxylan reached 1.50, 3.76, 0.64, 0.40, and 60%, respectively. Bijkerk, et al (2004) stated that the percentage of glucose reached 75% and arabinose 23% in plantagoseeds. Elsheikh. (2014) found that Plantago gum contains monosaccharides. Glucuronic acid recorded the highest percentage, reaching 15.3%, and the percentage of arabinose, rhamnose, and galactose reached 13.5, 2.2%, and 2.5% respectively. Al-Mahadawi, et al. (2019).stated that the lowest percentage of sugars in the gum of garden cress seeds was galactose and glucose, which amounted to 1.2 and 8.66, respectively, compared to other sugars. In contrast, the highest percentage of monosaccharides in the gum cress seeds was mannose and arabinose, which amounted to 17.71% and 18.71%. In comparison, rhamnose and fructose amounted to 8.74% and 9.60%. While gum arabic contained monosaccharides, which are rhamnose, which amounted to 13%, arabinose, 27%, galactose, 44%, and galacturonic acid, 15%. (Razavi, et al., 2014),

Williams, et al. (2000). Indicated that the gum of sage contained monosaccharides, which amounted to the highest percentage of mannose and galactose, which amounted to 60.19 and 33.76%, respectively. In contrast, arabinose and rhamnose were 1.48 and 1.57% respectively. Akdowa, et al (2014) found that the gum of *Grewia mollis* contained monosaccharides. The percentage of glucose was 1.80%, rhamnose 19%, xylose 5%, galactose 1% and arabinose 2%. Patel, et al. (2010) found that the gum of garden cress seeds contained a high percentage of mannose, 38.9% and the percentage of glucose was 1.0%. In comparison, the percentage of galacturonic acid was 15.32%. Phan, et al. (2020) found that the gum of *Plantago* contains monosaccharides linked to pectin (galacturonic acid and arabinoxylan). Furthermore, monosaccharides are linked to arabinoxylan (arabinose and xylose).

Table 4. Analysis of monosaccharides of gum of *plantago* seeds

sugar	Percentage
Fructose	4.2
Glucose	7.3
Xylose	44.12
Mannose	6.2
Arabinose	37

Amino acid analysis of *plantago* seeds and gum: Table (5) shows the amino acid analysis of *plantago* seeds and gum extracted from it. The results showed that the amino acid lysine recorded the highest percentage in the seeds, which amounted to 77.8 mg/100 g. In contrast, the amino acid leucine recorded the lowest percentage, 10.9 mg/100 g. As for the gum, the highest percentage was recorded by the acid serine, which amounted to 10.45 mg/100 g. In contrast, the lowest percentage was 4.58 mg/100 g for the amino acid lysine. The results also showed that the gum contained a number of polar amino acids, namely aspartic acid, asparagine, serine, tyrosine, arginine,

cysteine and histidine (6.25, 8.95, 10.45, 8.65, 7.14, 5.62 and 9.05) mg/100g, respectively. The results in the same table indicated that the *plantago* seeds and the gum extracted from the same seeds contained the essential amino acids, namely lysine, threonine, valine, methionine, histidine, leucine and phenylalanine, which amounted in the seeds to (77.8, 41.8, 22.8, 33.6, 24.9, 10.9 and 12.7) mg/100g. As for the gum, its percentages decreased and reached (4.58, 8.58, 6.59, 6.32, 9.05, 9.56, and 9.45) mg/100 g. This makes the gum of *plantago* seeds of good and high nutritional value. The results show that the amino acid lysine was higher than the rest of the amino acids in the seeds of *Plantago*, reaching 77.8%. In comparison, the percentage was 4.58% in the gum extracted from the same seeds. The low percentages of proteins are important in improving the functional properties of the gum. They work to encourage the absorption process of the gum as well as the formation of emulsions with high stability and stability from food systems (De Pinto, et al., 2002). Youssef, et al. (2009) found that the gum of acacia contained phenylalanine, the yield of which reached 1%. While the amino acid tyrosine, the yield of which reached 0.2%, and arginine, 20%. Mirhosseini, et al. (2012) mentioned that Durian seed gum contained a number of amino acids. The highest percentage was 43.02% for the amino acid leucine. The lowest percentage was 1.08 and 0.60% for the amino acids histidine and methionine, respectively. There is variation in the amino acid content of different gums. This is due to the variation in the protein content of the seeds as well as the differences in varieties and environmental conditions (Oomah, & Mazza, 1993). This variation in the composition of gums from amino acids reflects the nature of the protein components of each gum (Anderson & Wang, 1990).

Table 5. Analysis of amino acids of plantago seeds and the gum extracted from it

No	Amino acid	Plantago seeds (mg/100g protein)	Plantago Gum (mg/100g protein)
1	Aspartic acid	71.0	6.25
2	Asparagine	56.7	8.95
3	Lysine	77.8	4.58
4	Serine	32.6	10.45
5	Threonine	41.8	9.58
6	Isoleucine	52.9	8.65
7	Alanine	63.4	7.95
8	Valin	22.8	6.59
9	Tyrosine	36.6	8.65
10	Arginine	42.5	7.14
11	Cysteine	47.8	5.62
12	Methionine	33.6	6.32
13	Proline	70.1	8.00
14	Histidine	24.9	9.05
15	Lucien	10.9	9.56
16	Pheylalanine	12.7	9.45

Figure (1) Infrared spectrum analysis of plantago seed gum indicates the appearance of peaks at different frequencies when diagnosing the plantago seed gum under study. The

diagnosis was made using (FTIR) Spectroscopy technique shown in the spectral diagram.

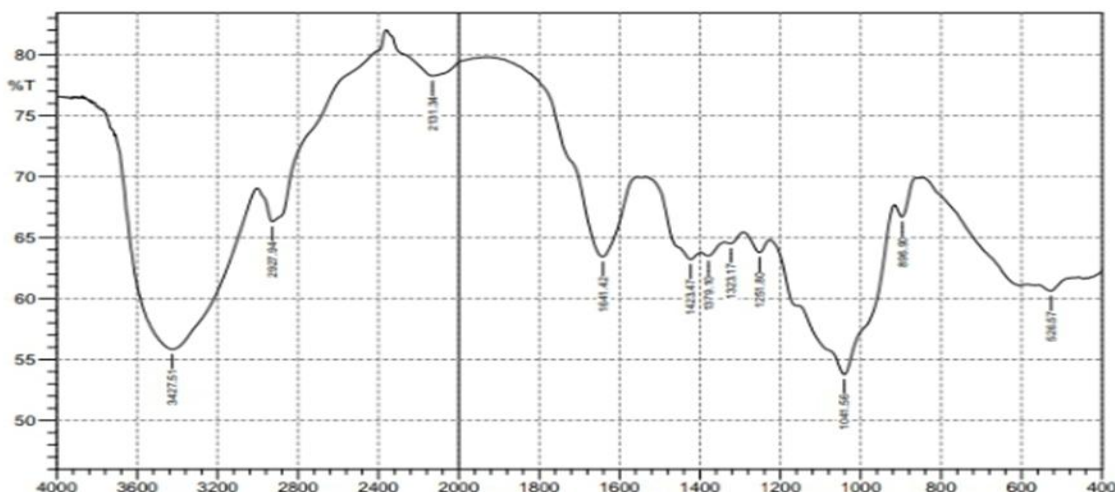


Figure 1. Infrared Radiation Spectrum Analysis of Plantago seed Gum

The absorbance at a frequency of 3427 cm^{-1} for the plantago seed gum indicates the presence of hydroxyl groups within the (O-H stretch) bond. This indicates the presence of carbohydrates in the gum. In contrast, the absorbance at a frequency of 2927 cm^{-1} indicates that the gum contained a (C-H) group. Absorption at a frequency of $1580\text{--}1650\text{ cm}^{-1}$ indicates that the gum contains amine groups (1, amines) in the (N-H) curve. This indicates the presence of protein. Also, the appearance of absorbance at a frequency of $1020\text{--}1250\text{ cm}^{-1}$ indicates that the gum contains a group of aliphatic amines with a bond extending (C-N). Akdowa, et al (2014) mentioned that when diagnosing the gum of garden cress seeds using the (FTIR) technique, the presence of both carbonyl groups (C=O) at

a frequency of 1743 cm^{-1} and the aldehyde group (CHO) at a frequency of 2900 cm^{-1} . And hydroxyl groups (OH) at a frequency of $3475\text{--}3414\text{ cm}^{-1}$. Also, the appearance of absorbance at a frequency of 1539 cm^{-1} . This indicates the amides groups (NH), which indicate the presence of protein. While Akbari & Ghoreishi (2017) indicated when studying the gum of garden cress seeds using (FTIR) technique, the presence of (C=O) groups at a frequency of 1620 cm^{-1} and (OH) groups at a frequency of 3416 cm^{-1} . And (CH) groups at a frequency of 2924 cm^{-1} and (C-O) groups at a frequency of 1128 cm^{-1} . Al-Zarfi (2023) revealed when studying the gum of chia seeds using (FTIR) technique. The appearance of absorbance at a frequency of 3429.43 cm^{-1} indicates the presence of hydroxyl groups

(OH), which indicates the presence of carbohydrates in the gum. The absorbance appeared at a frequency of 2931.80 cm^{-1} , indicating the methyl groups (C-H), which indicates that the gum contains flavonoids and phenolic compounds. And the appearance of the (C=O) group. At a frequency of 1726.29 cm^{-1} and a group of B-anomeric C-H and glycosidic linkages at a frequency of 712.38 cm^{-1} . Al-Aubadi, & Al-Ani (2017) indicated that when studying basil gum using the (FTIR) technique, the appearance of absorbance at frequencies of 3433 and 3394 cm^{-1} indicates the presence of amine groups (N-H). This indicates the presence of protein, while the absorbance at a frequency of 2904 cm^{-1} indicates the presence of asymmetric aliphatic (C-H) groups, while at a frequency of 2893 cm^{-1} , the appearance of symmetric aliphatic (C-H) groups is the type of vibration Stretching for carbonyl groups at frequencies of 1072 and 1053 of the bending type.

CONCLUSIONS

The present research concludes that flax seeds and the gum produced from it contain substantial amounts of protein, dietary fiber, and ash. Moreover, important amino acids such as lysine, threonine, valine, methionine, histidine, leucine, and phenylalanine cannot be synthesized by the human body and must be obtained from dietary intake. A collection of significant and minor minerals. The primary elements consist of sodium, potassium, calcium, magnesium, and phosphorus. Conversely, the trace elements include iron, zinc, and copper. Elevated levels of xylose and arabinose sugars distinguished the gum derived from flax seeds. It included hydroxyl groups (OH), amine groups (N-H), and carbon-hydrogen groups (C-H). Consequently, using plant gums in the food business is advantageous due to its nutritional advantages and lower manufacturing costs relative to commercial gums.

AUTHOR/S DECLARATION

We confirm that all Figures and Tables in the manuscript are original to us. Additionally, any Figures and images that do not belong to us have been incorporated with the required permissions for re-publication, which are

included with the manuscript. Author/s signature on Ethical Approval Statement. Ethical Clearance and Animal welfare Funds:

CONFLICT OF INTEREST

The authors declare that they have no conflicts of interest.

DECLARATION OF FUND

The authors declare that they have not received a fund.

AUTHOR'S CONTRIBUTION STATEMENT

All authors contributed to the conception and design of the experiment, data collection, statistical analysis, interpretation of results, and writing of the manuscript. All authors reviewed and approved the final version of the manuscript.

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دراسة التركيب الكيميائي وتحليل طيف الأشعة تحت الحمراء لصبغ بذور لسان الحمل

فاطمة شفاء عباس، وداد فاضل عباس

قسم الاقتصاد المنزلي /كلية التربية للبنات/ جامعة بغداد

المستخلص

هدفت الدراسة الحالية الى تعيين التركيب الكيميائي لبذور لسان الحمل والصبغ المستخلص منه، اذ تم تقدير كلا من البروتين والدهن، الرماد، والرطوبة، والالياف، والكربوهيدرات الكلية، واشارت النتائج الى ارتفاع نسبة الكربوهيدرات في الصبغ مقارنة بالبذور اذ بلغت 63.1 و 44.2% على التوالي. تم تحليل بعض العناصر المعدنية الكبرى والصغرى ووجد ان البذور والصبغ احتوى على نسب جيدة من الصوديوم والبوتاسيوم والكالسيوم والمغنيسيوم والفسفور فضلا عن الحديد والزنك والنحاس واشارت نتائج تحليل الاحماض الامينية لبذور وصبغ بذور لسان الحمل بتقنية HPLC ان الحامض الاميني اللايسين كان نسبته اعلى من باقي الاحماض الامينية في بذور لسان الحمل قد بلغت 77.8% بينما كانت نسبة 4.58% بالصبغ المستخلص من البذور ذاتها اما في الصبغ فكانت اعلى نسبة سجلها الحامض السيرين الذي بلغ 10.45 ملغم /100غم، وظهرت نتائج تحليل السكريات الاحادية ارتفاع محتوى الصبغ من السكر الاحادي الزايلوزوالارابينوز بلغ 44.12 و 37% على التوالي.

الكلمات المفتاحية: الأحماض الأمينية، الهلام، السكريات الأحادية.