Chemical Composition and Antibacterial Activity of Ceratonia siliqua L. Growing in Boumerdes (Algeria)

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***Abstract*-**This work is a contribution to the knowledge of physicochemical characteristics of mature carob followed by evaluation of the activity, antimicrobial phenolics leaves and green pods of *Ceratonia siliqua* L. physicochemical study shows that mature carob it has a considerable content of sugar (50.90%), but poor in proteins (7%), fat (8%) and also has a high mineral content. The results obtained from phenolic extracts of leaves and green pods of *Ceratonia siliqua* L. show a wealth leaf phenolic extract especially flavonoids (0,545mg EqQ / g) relative to the extract of green pods (0,226mgEqQ / g). Polyphenols leaves have a slightly inhibitory effect on the growth of strains: *Staphylococcus aureus, Escherichia coli, Klebsiella pneumoiae, Streptococcus sp and Sanmonella enteritidis,* a strong inhibitory effect on the growth of *Pseudomonas strain aerogenosa*. Moreover, polyphenols pod have a slightly inhibitory effect on the growth of *Streptococcus* sp strains, Pseudomonas and aerogenosa *Sanmonella enteritidis*, a slightly inhibitory effect on the growth of *Klebsiella pneumoniae* strains, E. *coli* and *Staphylococcus aureus*.

Keywords*-Antimicrobial activity, bacteria, clove, Ceratonia siliqua and polyphenols.*

I.INTRODUCTION

The carob tree (*Ceratonia siliqua* L. 1753, Fabacae Cesalpinoïdae) whose origin appears to be the eastern Mediterranean. It agro-forestry-pastoral species with enormous socio-economic and ecological interests. The carob tree is of interest increasingly growing not only because of its hardiness, its indifference vis-à-vis the nature of the soil, the wood quality, its ornamental and landscape value, but mainly for its seeds which are the subject of commercial transactions whose value far exceeds that of timber production. Thus, whole cloves, pulp, seeds and gum are subject to significant trade towards Europe and are widely used in the food industry [1].

Carob is currently much interest in Algeria, or industrial dispute the international market, for export in the form of flour derived from the pulp and seeds for their farming culture. Furthermore, this tree is of considerable economic importance; pods, rich in sugar cane and sugar beet are used in food industry and pharmacology, particularly as antidiarrheal, their fiber confers cholesterol-lowering and glucose-lowering properties; phenolic compounds they contain are responsible for their antioxidant property [2].

The carob tree (Ceratonia siliqua) is an agro-forestry-pastoral species with enormous socio-economic and ecological interests. With its aptitude to develop the different strategies to adapt to water stress, the tree moved favorably in arid and semi-arid areas.

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Mediterranean ecosystems are characterized by low and erratic precipitation and long dry summer periods. These climatic constraints combined with human pressure, generally lead to degradation of plant cover and rapid soil erosion. To counteract this problem, save soil fertility and improve the living standards of the rural population, the use of multiple-use pioneer tree species such as carob, adapted to climatic and can settle on marginal lands in reforestation programs and restoration of degraded soils remains a good strategy [3].

II. MATERIALS AND METHODS

Biological Material

The biological material used in this study consists of the pods and leaves of the carob tree *Ceratonia siliqua* and certain human pathogenic microbial strain.

Plant Material

Mature pods of the carob tree *Ceratonia siliqua* were collected in the region of Lakhdaria (Bouira) in August 2012, in order to achieve a physicochemical study.

In order to study the antimicrobial activity, extraction of polyphenols is made on immature pods and leaves of carob harvested in April 2013, in the forest of Sidi Douad (Boumerdes).

Botanical classification of *Ceratonia siliqua* is as follows:

Kingdom: Plantae
Phylum: spermaphytes
Sub-Phylum: Angiosperms
Class : Equisetopsida
Order : Fabales
Family : Fabaceae
Genus: Ceratonia
Species: *Ceratonia siliqua* L. [4]

Carob is an ecologically important tree, industrial and ornamental indiscutable.En terms of products, the tree and all its components are useful, especially the fruit. It is used for afforestation and reforestation of areas affected by erosion and desertification, also used as an ornamental plant on roadsides and gardens (Fig.1) [4].

Currently, he is considered one of the most successful fruit and forest trees, since all its parts (leaves, flowers, fruits, wood, bark and roots) are useful and have values in several fields(Fig.2 , Fig.3) [5].

The fruit of the carob or carob pulp consists of a wrapping regular seeds. Indeed the sweet pulp of the carob has long been used as cattle feed side other foods such as barley flour [6].

Fig.1. The carob tree

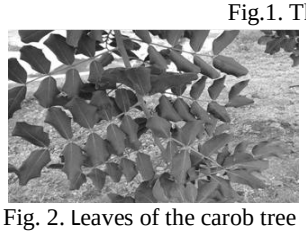

Fig. 2. Leaves of the carob tree

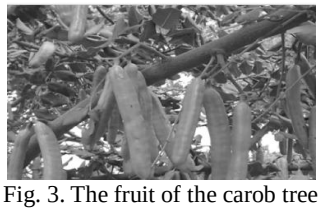

Fig. 3. The fruit of the carob tree

Carob is frequently grown in the Saharan Atlas and it is common in the tell [7] It is found naturally in association with Prunus dulcis, Olea Europea and Pistacia Atlantica in hot semiarid floors, sub-humid and humid, with an altitude ranging from 100m to 1300m in the cool valleys that protect

it from frost, with a temperature of 5 ° C to 20 ° C and rainfall of 80mm to 600mm / year[8].

Microbial Tested Strains

To evaluate the antimicrobial activity of the polyphenol extract of the pod and leaf carob, eight microbial strains were evaluated six bacteria *Staphylococcus aureus, Streptococcus* sp, *Klebsiella pneumoniae*, *Pseudomonas aeruginosa*, *Escherichia coli*, *Salmonella enterica*, and *Aspergillus Niger* and *yeast Candida albicans.*

The microbial strains are stored on nutrient agar for bacteria and the mushroom to Sabouroud and yeast.

Physico-Chemical Study

The assay is performed according carbohydrates method [3]. [9] The protein characterization is performed quantitatively. The determination of lipids was performed with a Soxhlet appliance.

Determination of Ash Content (Mineral Matter)

The principle consists of a biological material incineration in a muffle furnace, in a porcelain crucible at a temperature of 900° C.

III. RESULTS AND DISCUSSION

Determination of Dry Matter

The rate of the pulp in the dry matter of the carob Lakhdaria The area was estimated to 88.5%. The result of this study is almost identical to those found by [10]. who found value of 88.68% for pulp Blida, but slightly less than that of the pulp and pulp of Tlemcen, Jijel which are respectively 89.40% and 90.40% that indicated by its but in this case the difference is not significant, and against it is less than that given by [11], [12]. Which were respectively 90%. 95.4%. The water content is 11.5% of the study is a dry variety variety because it has a lower water content to 26% as shown. This low water content fruit protects against the growth of microorganisms which promotes its long shelf life.

TABLE I
Physicochemical Characteristics Of The Carob Pulp.

Settings	**Values**
Water content	11.5%
The dry matter content	88.5%
Total sugar content	50.9%
Protein content	7%
Lipid content	8.8%
titratable acidity	2.1%
Rate ashes	3.64%
Soluble solid residues	14.4%
pH	5.52

The rate of total sugar 50.9% MF, also this value is lower than that specified by [1], 75% and it is higher than that carried out by [13]. which is 40% value protein of carob pulp is 7% of the MF, (Tab.I) the value is equal to that carried out by [13]. that it is close to the pulp, [14]. which is 7.1%. But it is higher than that found in [15]. which has a reported value of1% to 2% MF.

The fat content of the carob pulp is 8.8%, this value is greater than that found in [16]. , which is 4.80%. While the result is much higher than those of [11], which is (0.74%), to Jordan, those is (0.6%) for Italy [17].

The fat of the carob pulp was 8.8%. This value of the joining [17]. which is 6.6% for the most part represented by oleic acid (34.4%) and linoleic acid (44.5%), whereas palmitic acid (16.2%) and stearic acid (3.4%) were the major saturated fatty acids. Which gives the carob the property of reducing the risk of cardiovascular disease.

The rate of ash is the total amount of minerals present in a sample, the value of the carob pulp is in the order of 3.64%, it exceeds the range of 2% to 3% [18], against our value is less than 8.83% [19]. This can be explained by the geographical origin of the samples, including climate conditions and soil characteristics of the soil [20].

Element Analysis of Minerals

TABLE II
Mineral Composition Element of The Pulp of The Carob Tree

Mineral Element	Na	Zn	Cu	Mg	Ca	K
Quantity in mg/100g Of The Carob Pulp	14 .86	0.66	0.46	39.77	206.90	1132.96

The result of this study is close to those reported by [21] is the following value (1486.25mg/100g). The magnesium content of the carob pulp is 39.77mg/100g MF (Tab. II) It is below the values 66,89mg/100g, 60 mg /100g indicated by [22] and [23].

Yield Phenolic Compounds

The yield of the phenolic compound or methanoic extracting polyphenols obtained from the crushed leaves and green pods are respectively 20%, 10% of the fresh material. The yield of the phenolic compound of the sheets is greater than 2 times per input to yield phenolic compound green pods. This result confirms the work [24] and [25] have shown that the leaf and bark are rich in phenolic compounds over other parts of the tree.

TABLE III
Content Of Phenolic Compounds Extracted From The Leaves And Green Pods.

Concentration Of Active Principle	Concentration Of Total Polyphenols (EAG mg/gMF)	Flavonoid Concentration (mg EqQ/g MF)
The leaf	1.55	0.545
The pod	1.57	0.226

Total Polyphenol Content

The extract of green pods is a major source of total polyphenols comparable to the extract of the leaves. Green carob pods contain 4.52 mg/g of total polyphenols that are greater than this study [26].

Antimicrobial Activity

Diffusion Test on Agar Medium

TABLE IV
Diameter Of Inhibition Zone Of The Polyphenolic Extract Of Pods

Diameters Of Inhibition Zones (mm)	1st test	2nd test	3rd test	Mean Diameter
Staphylococcus aureus	4	15	10	9.66±5.50
Streptococcus sp	14	20	25	19.67±5.50
Escherichia coli	11	5	15	10.33±5.05
Klebsiella pneumoniae	11	14	13	12.66±1.52
Pseudomonas aerogenosa	18	16	15	16.33±1.52
Sanmonella enteritidis	18	17	16	17±1
Candida albicans	/	/	/	/
Aspergillus niger	/	/	/	/

TABLE V
Diameter Of Inhibition Zones Leaves Extract

Diameters Of Inhibition Zones (mm)	1st test	2nd test	3rd test	Mean Diameter
Staphylococcus aureus	15	14	17	15.33±1
Streptococcus sp	25	23	27	25±2
Escherichia coli	20	19	22	20.33±1.52
Klebsiella pneumoniae	21	19	22	20.66±1.52
Pseudomonas aerogenosa	24	25	27	25.33±1.52
Sanmonella enteritidis	20	22	19	20.33±1.52
Candida albicans	/	/	/	/
Aspergillus niger	/	/	/	/

The polyphenol extract *Cumoinum cyminum* L. has no effect on the growth of strains, *Serratia sp*, and *Bacillus subtilis*, it is only on the growth of *Staphylococcus aureus* [27] and confirms hypersensitivity latter strain our phenolic extract of the leaves. This hypersensitivity of the *Staphylococcus aureus* strain may be explained by the capacity of the bactericidal carob pulp with respect of *Staphylococcus aureus*. Also carob adsorb enterotoxins produced by certain strains of *Escherichia coli* and *Staphylococcus*, as well as the cholera vibrio, this adsorption mechanism could be explained by the presence of tannins and insoluble in the active part of the locust bean [28].

The antimicrobial activity of the extract of the leaves is greater phenolic especially intestinal strain relative to the phenolic extract pod. These results are demonstrated by experimental studies in Turkey, carob leaves used in medicine 'traditional' to treat diarrhea and dietary food [29]. These leaf extracts have also been identified as carriers of cytotoxic and antimicrobial activities [30]antifungal . Activité practice is zero for both phenol extract (leaf, clove immature) by cons according to[31] carob also has antimicrobial and antifungal activity which is due to its content of phenolic compounds.

IV. CONCLUSION

A comparative study between the statements of the pod and leaf of the plant is desirable. It is very interesting to complement and enhance this study by:

A detailed HPLC polyphenolic profile separation of various polyphenolic fractions and evaluation of antimicrobial and antioxidant activities for each fraction separately. And to think about the contribution to the study of other biological activities.

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