Ceratonia siliqua L. A promising functional food for chronicle diseases related to gastrointestinal system: diabetes, and lactose intolerance.

To**ma Nardjes Mouas [1,*], Zahia Kabouche [1], and Randa Boufoula[2]**

[1] Université frères Mentouri-Constantine1, Laboratoire d'Obtention de Substances Thérapeutiques LOST, Campus Chasbet Ersas, 25000 Constantine, Algeria;

[2] Constantine 25000, Algeria;

•Corresponding author: mouas.toma.nardjes@umc.edu.dz

Abstract: The present study contributes to the promotion of a tree widely cultivated in the Mediterranean area, but not enough in our country Algeria; the carob tree "*Ceratonia siliqua* L."; by a mini bibliographic review which lists the agronomical, chemical, nutritional, biochemical, biological, and biotechnological properties of carob and its by-products; which lists environmental benefits, in addition to chemical, nutritional, biochemical, biological, and biotechnological properties of carob and its by-products expressed by the evaluation of its biological activities: antioxidant, anticancer, anti-hyper-lipidemic, anti-diabetic, anti-reflux, anti- diarrheal, antibacterial, anti-inflammatory, antiulcer and enzymatic, noted in the literature for few years using a survey on several databases MDPI, Pubmed, Google scholar, Elsevier...

It also highlights environmental benefits on soil and biodiversity besides, the presence of the main primary and secondary metabolites: polyphenols, fibers and sugars; give these products very interesting properties and benefits for human health by making it dietetic product and a raw material of choice in food, pharmaceutical and biotechnology industries, in this perspective a *Ceratonia siliqua* L. fruit aqueous extract based vegetal milk was developed in our laboratory as a functional food for chronicle diseases related to digestive disorder: diabetes, lactose and gluten intolerance.

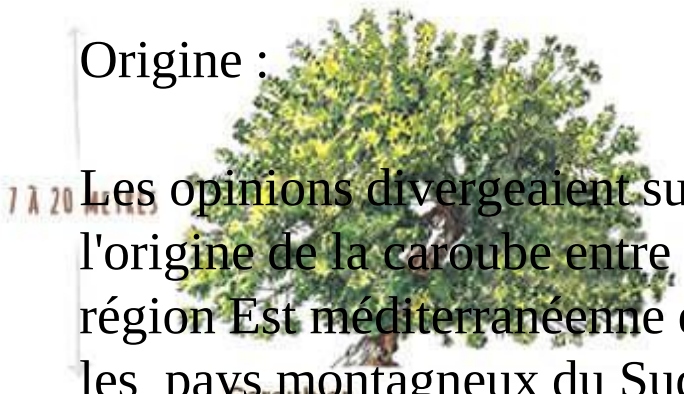
This contributes to the revive of a forgotten and neglected tree in our country by the enhancement of its crucial role in the preservation of soil, biodiversity, environment, human health and security, and consequently attract local authorities on the importance of its culture.

Keywords : Mediterranean local forester products, *Ceratonia siliqua* .L, Carob, functional food, nutraceuticals.

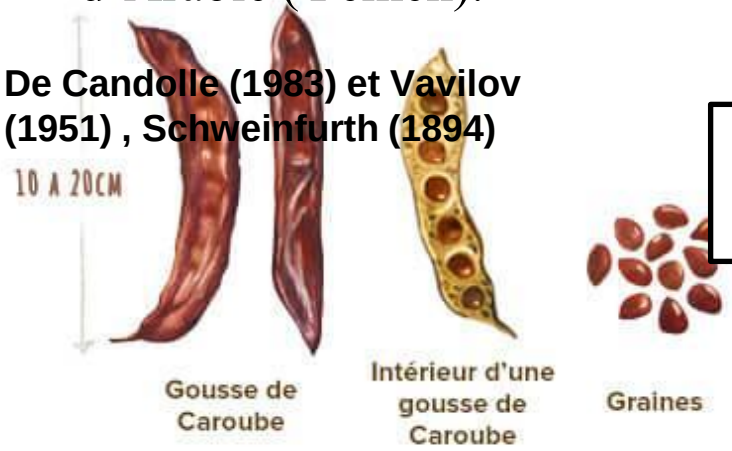
Ceratonia Siliqua .L calssification

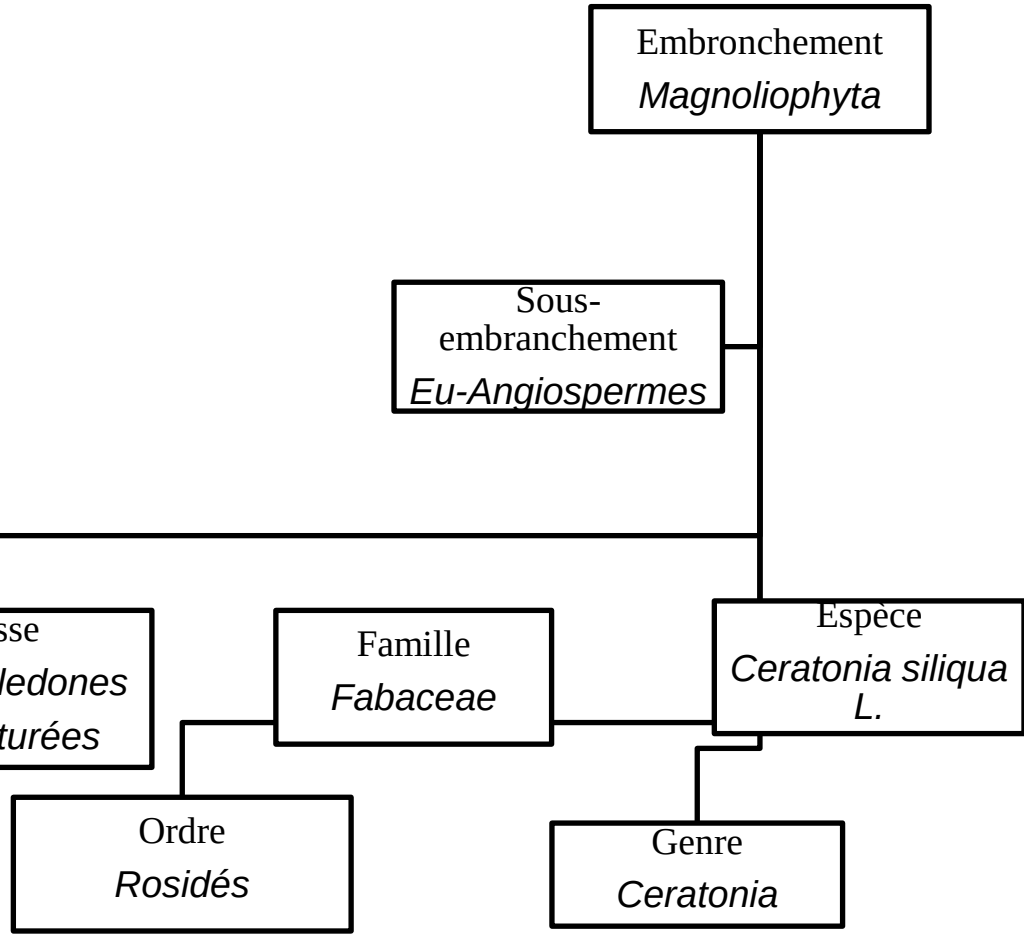
Origine :

Les opinions divergeaient sur l'origine de la caroube entre la région Est méditerranéenne et les pays montagneux du Sud d'Arabie (Yémen).



De Candolle (1983) et Vavilov (1951) , Schweinfurth (1894)





(APGII, 2003)

Distribution

Cultivar :

Ecology:

-C

morpho

te

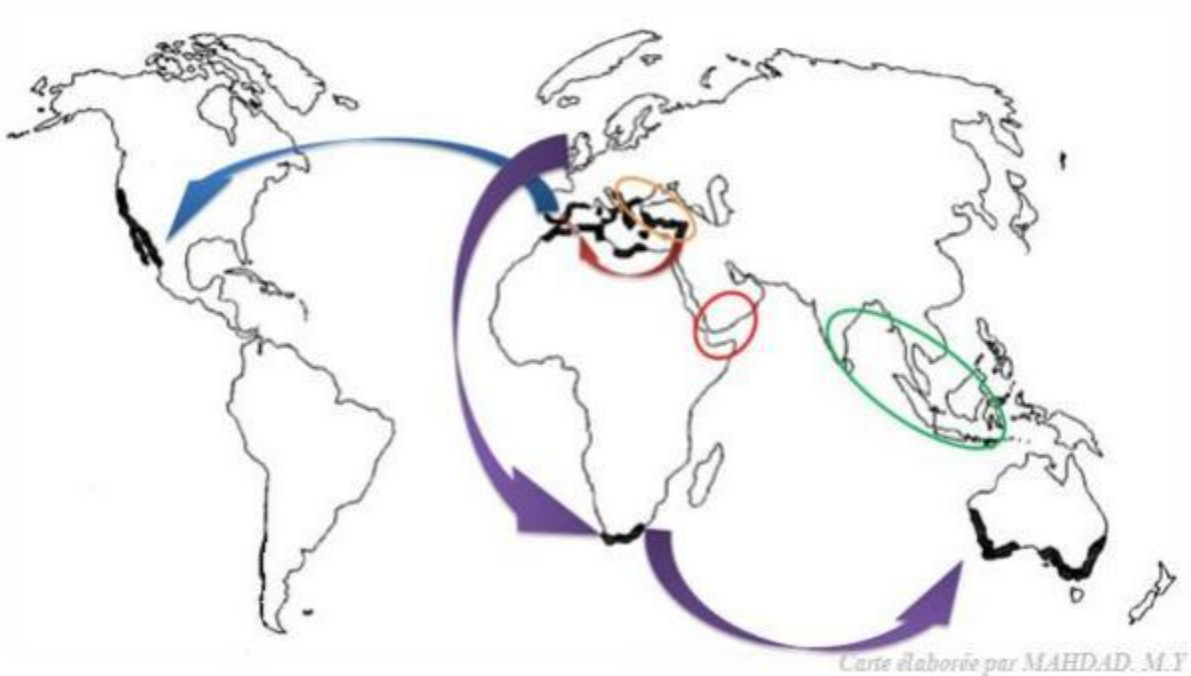
-leur a

qualit

graines

leur rés

(Bat



Centre d'origine et distribution du caroubier dans le monde (dspace . univ-telmcen . dz)

ophile

**séchasse

oid

lusieurs types

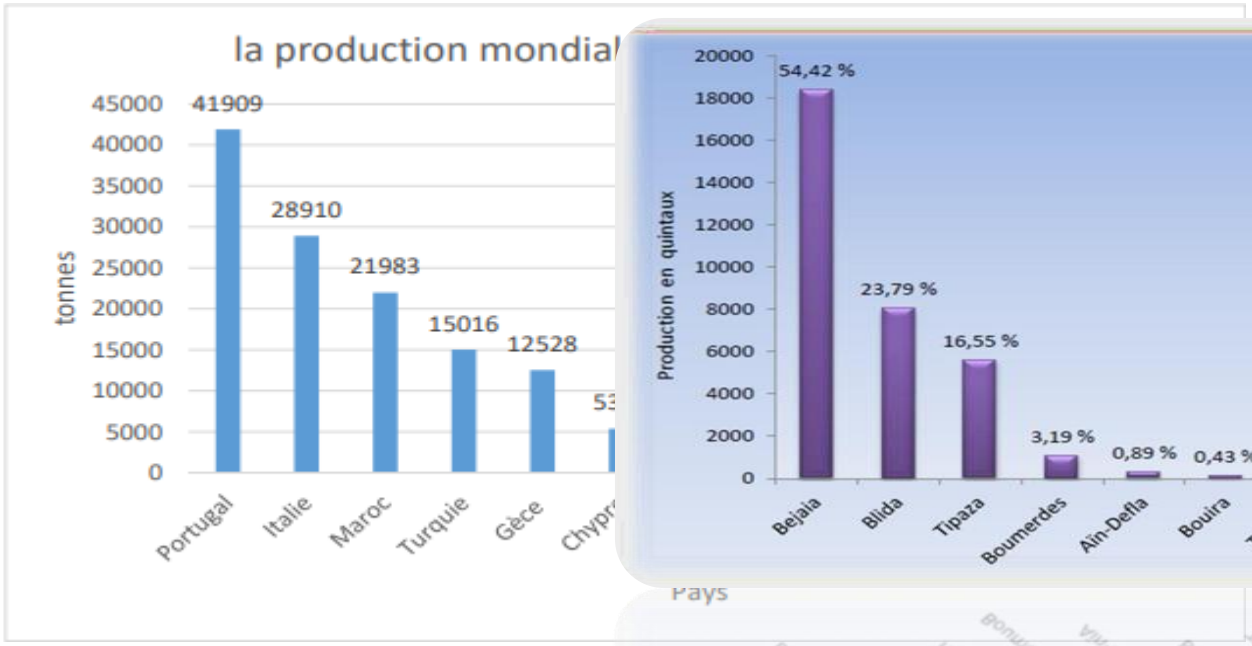
sols

- contre la dégradation
- contre la désertification

(Baum, 1989 ; Sbay et Abrouch, 2006 ; Zouhair, 1996, BAUM, 1989).

Production :

La production mondiale annuelle de caroube est essentiellement méditerranéenne ;(Afrique du nord et le sud de l'Europe)



Production mondiale de la caroube en 2017 ***(FAOSTAT 2019)***

Production de la caroube en Algérie, **(DSA de Tlemcen,**

USES

Traditionnel

L'utilisation des différents partie du caroubier en médecine traditionnelle est indiquée surtout pour les maladies du système gastro-intestinal (Diarée , gaze intestinal, Anémie, favorise l'appétit...etc)
(Ouelbani Rayene; Bensari Souheir; Mouas Toma Nardjes; Khelifi Douadi. (2016).)

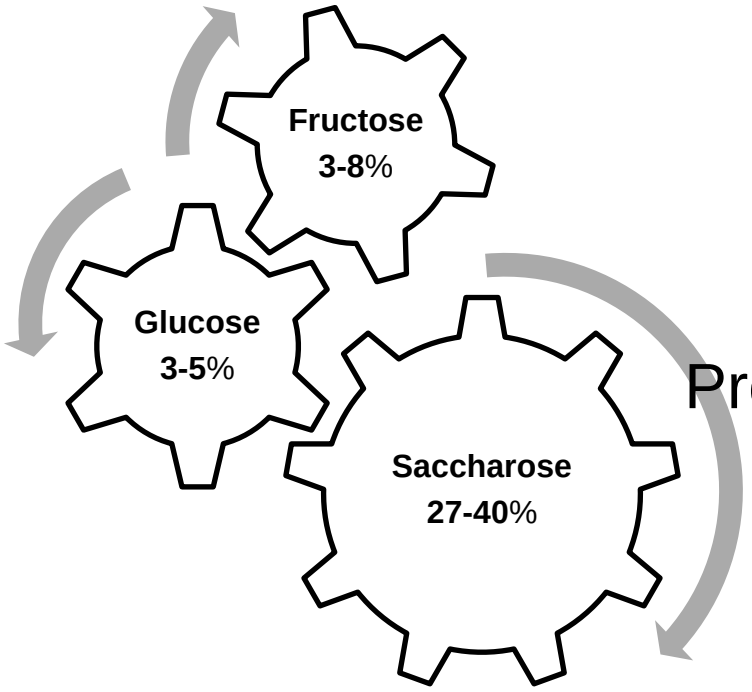
Actuelle

- **Animale:** La gousse et les feuilles sont utilisées dans l'alimentation des ruminants et des non ruminants.**(Louca et Papas, 1973)**
-**Humaine :**La farine de la caroube est employée surtout en agro-alimentaire , sous de nombreuses formes :

la gousse et la gomme de caroube sont utiliser comme :
1/ ingrédient potentiel dans les aliments dérivés des céréales pour les personnes cœliaques (farine sans gluten)
; 2/ coup de faim pour les régimes alimentaires
3/ préparation du chocolat, remplaçant: farine , sucres. cacao

Composition

Sugar : (la pulpe 40-60 %)

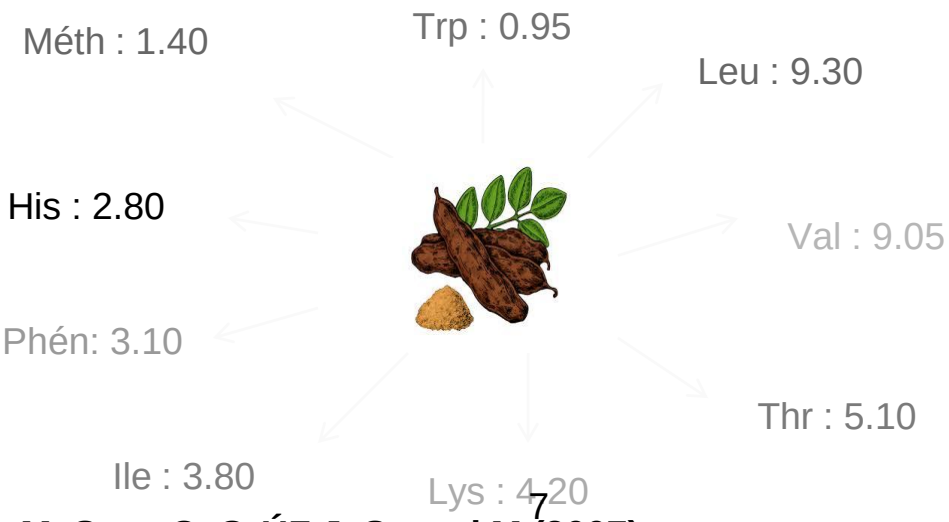


Avallone R, Plessi M, Baraldi M, Monzani A (1997)

Lipids: (0,4 et 1,3 %)

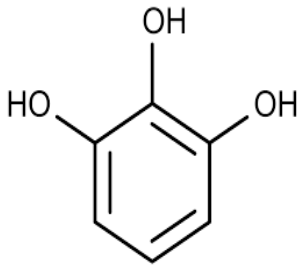
le caroubier peut être considéré comme une source alimentaire plus saine et peut être un ingrédient idéal pour la production de produits à faible teneur en matières grasses.

Protéine : (Graines / AA essentiel) g /100g



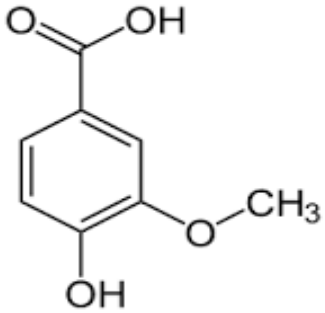
Ayaz FA, Torun H, Ayaz S, Correia PJ, Alaiz M, Sanz C, GrÚZ J, Strnad M (2007)

Pyrogallol



4970,18 ppm

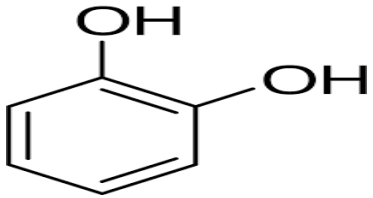
Vanillique



13,92 ppm

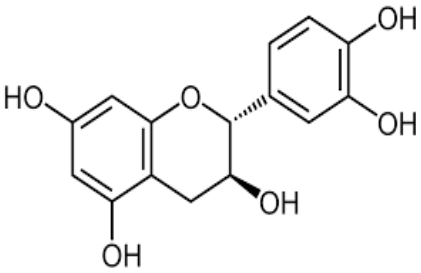
•Poly phénol
•(16 -20 %)

Catéchol



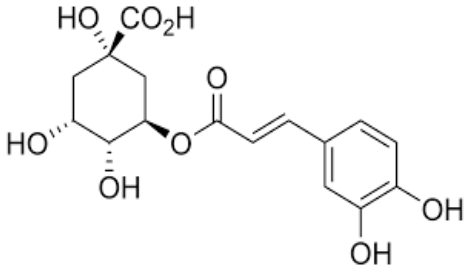
164,67 ppm

Catéchine



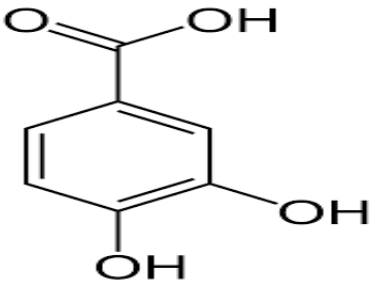
27,97 ppm

Chlorogénique



101,09 ppm

Protocatéchine



79,47 ppm

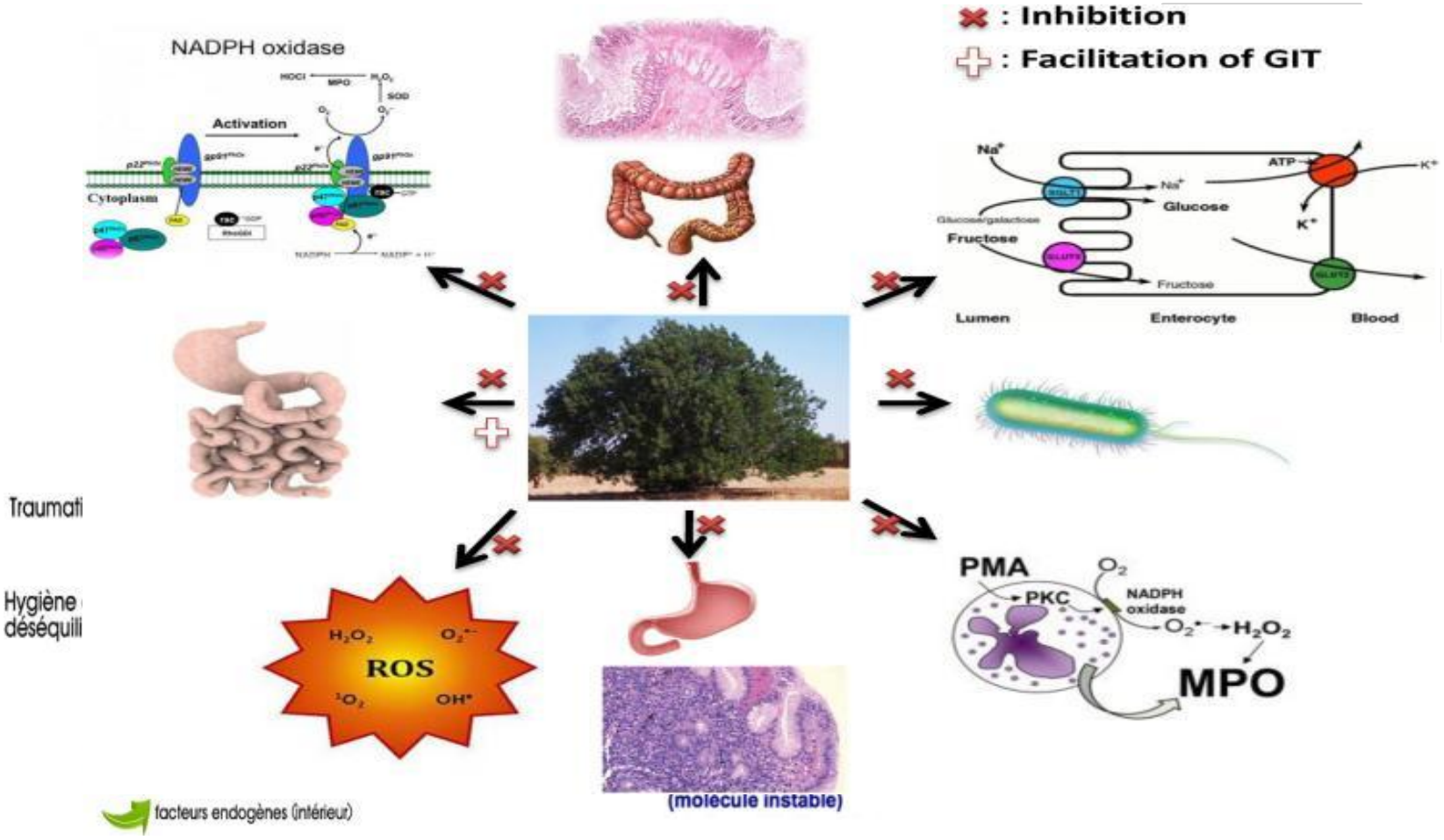
(Kamal .M, Youssef .E , Moshera M. El-Manfaloty, Hend M. Ali, (2013)).

Carob pulp as substitut of cacao

Component	composition des graines de cacao (%)	composition de pulpe de caroube (%)
Protéines	10.0–16.0	2.0–7.6
Graisses	36.8–57.0	0.4–1.3
Fibre	2.1–15.0	7.6–38.0
Sucres	0.4–3.5	40.7–54.7
Cendre	2.6–8.7	2.0–3.4
Caféine	0.1–1.0	Montant de la trace
Total poly phénols	4–18a	1.2–7.0a

Composition of cocoa beans and carob pulp **(Loullis Andreas 2018)**

Antioxidant activity



- lipidic peroxydation inhibition

Protège les cellules **(Rtibi et al,2015)**

- ↘Cytotoxicité **(Lobo et al. 2010)**

- SOD et CAT ⟶ Elimination des ROS **(Rtibi et al. 2015)**

- Inhibition de MPO ⟶ $Cl^- + H_2O_2 + H^+ \longrightarrow HOCl + H_2O$ **(Rtibi et al. 2015)**

- Inhibition de la phosphorylation du p-47phox-ser-328 **(Rtibi et al. 2015)**

Anti cancer activity

Extrait de fibre de caroube
(Johns et Houlston, 2001)

Fibers + poly phénols

-

Prolifération de l'adénome et les cellules adénocarcinome

(Corsi et *al*, 2002).

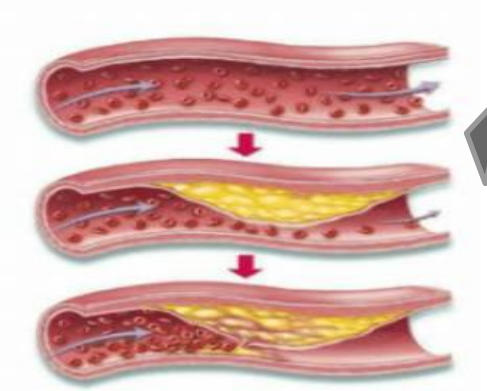
Anti-hyper-lipidimic activity

Fibre

- Digestion des graisses
- Contrôle le cholestérol total
- ↘ le taux de LDL et Triglycéride

(Macho-Gongàlaz et al, 2018)

Fibre soluble **Fibre insoluble**



Athérosclérose (**Valero-munoz et al,2017)**

↘ Cholestérol plasmatique
(Evan et al, 1992)

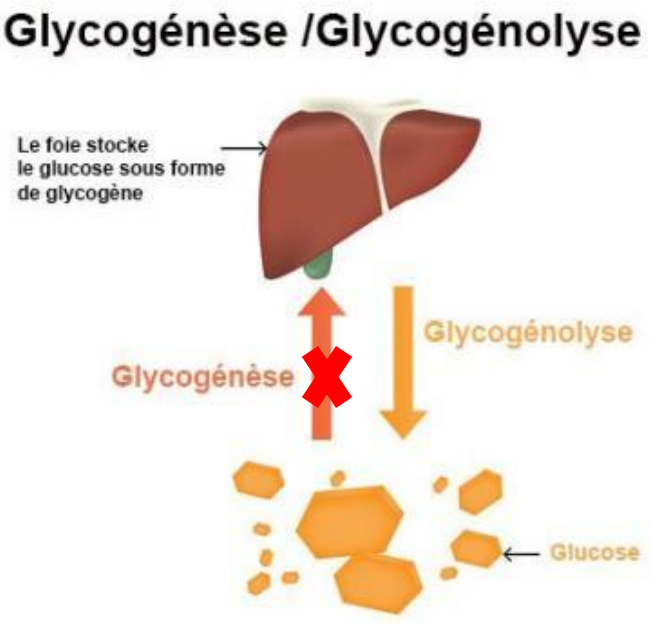
Antidiabétic activity

Extrait de gomme de caroube joue un rôle dans la régulation du glucose de sang.

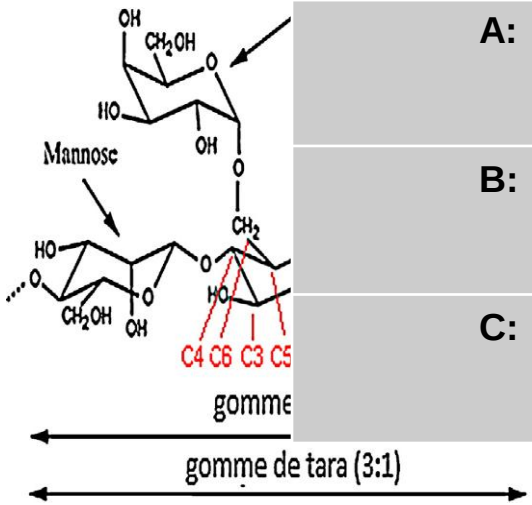
Glucose **(Forestieri et al, 2010)**

Glycogénèse

Glycogène



Anti-reflux activity



Formue épaissies de gomme	Indice de reflux
A: 0,33g/100ml	**Plus efficace**
B: 0,45g/100ml	
C: 0,45g/100ml	

risson

régurgitation
(Miyazawa R, et al 2004)

Femme enceinte

- Améliore les symptômes du reflux gastro-œsophagien, tels que les pleurs et les troubles du sommei l

(Orenstein SR, et al 1987)

Anti diarrhéic and antibacterial activity

Extrait aqueux

Bactéries	Extrait de feuille	Action
Escherichia coli ATCC 25922	**N-hexane**	**Inhibition de la croissance (Kivçak et Coll, 2002)**
Escherichia coli ATCC 11230	**Tous les extraits**	
Escherichia coli ATCC 29998	**Méthanol**	
Staphylococcus aureus ATCC 29213	**Ethanol Méthanol Extrait aqueux**	
Staphylococcus epidermidis ATCC 12228		

A

Anti inflammatory and anti ulcer activity

Extraits aqueux

- Les tissus enflammés et le plasma du colon **(Rtibi et al, 2016)**
- Prévenir les lésions macro et microscopique de muqueuse
- Poly phénols (Flavonoïde) **(Rtibi et al, 2015)**

Conclusions The present bibliographic mini review on carob tree and its organic derivatives (pods, pulp, seeds, flowers, leaves), exhibits its richness in several primary (fibers, hydrocarbs) and secondary metabolites (phenols, Gallic acids, catechins, quercetin, tannins...) which content and profile depend on plant studied part, soil, climate, cultivar, extraction and characterization methods. Besides, an important antioxidant activity, a high nutritional value and dietary profile make its plant parts derivatives very interesting functional foods, dietary supplements, adjuvant in pharmaceutics, nutraceutical, to treat several chronically diseases related to nutrition such as cancer, diabetes, ulcer, gluten intolerance...

In this regard, a range of dietary products was developed in our laboratory: free gluten floor, molasses, vegetable milk, tires, to promote local organic products for a sustainable eco-responsible economy.

Acknowledgments

Authors would like to thank Algerian Ministry of Higher Education and Scientific Research DGEFS, and the Algerian Directorate General for Scientific Research and Technological Development DGRSDT for financial fund.