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INSTITUTE OF ENGINEERING; UNIVERSITY OF ALGARVE; CAMPUS DA PENHA; FARO-PORTUGAL

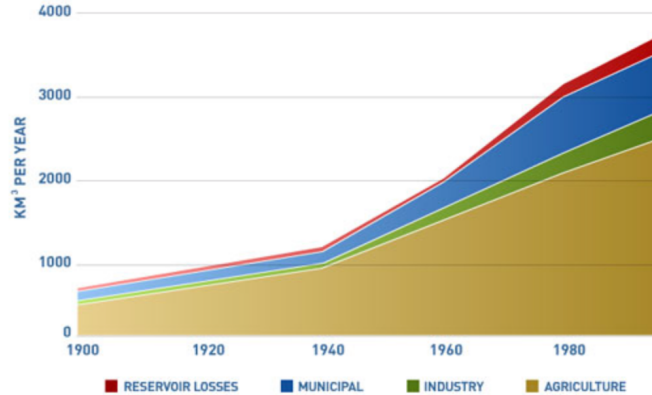
**TOWARDS SUSTAINABLE MEDITERRANEAN  
BAKERY PRODUCTS – TESTING FORMULATIONS  
WITH SUNDRIED CAROB PULP AND SEED FLOUR  
(*Ceratonia siliqua* L.)**

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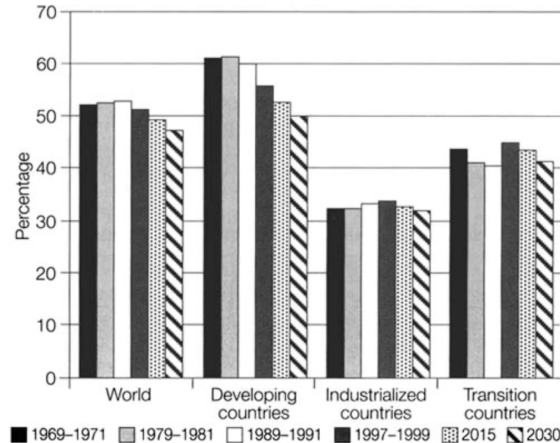
# Water – Food – Energy nexus is the key to sustainable development

ESTIMATED WORLD WATER USE



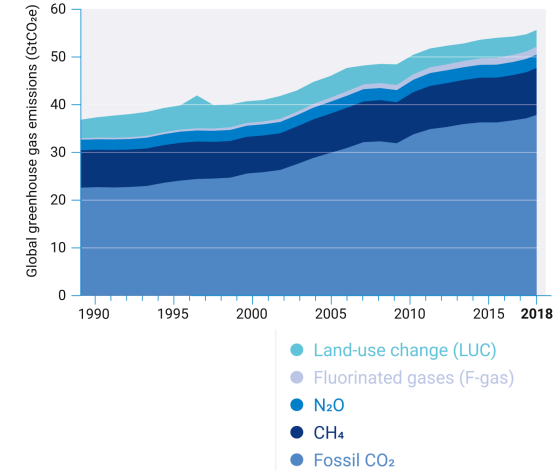
<https://www.unwater.org/water-facts/water-food-and-energy/>

Figure 1. The share of dietary energy derived from cereals



<http://www.fao.org/3/AC911E/ac911e05.htm>

Figure 2.1. Global greenhouse gas emissions from all sources



<https://www.unenvironment.org/resources/emissions-gap-report-2019>

## Mediterranean resources:

- Rich agrobiodiversity / well adapted plants
- Mediterranean Diet (healthy and sustainable food pattern, crafts and lifestyle)
- Ancient wisdom – Sun drying

# The carob tree

(*Ceratonia siliqua*)

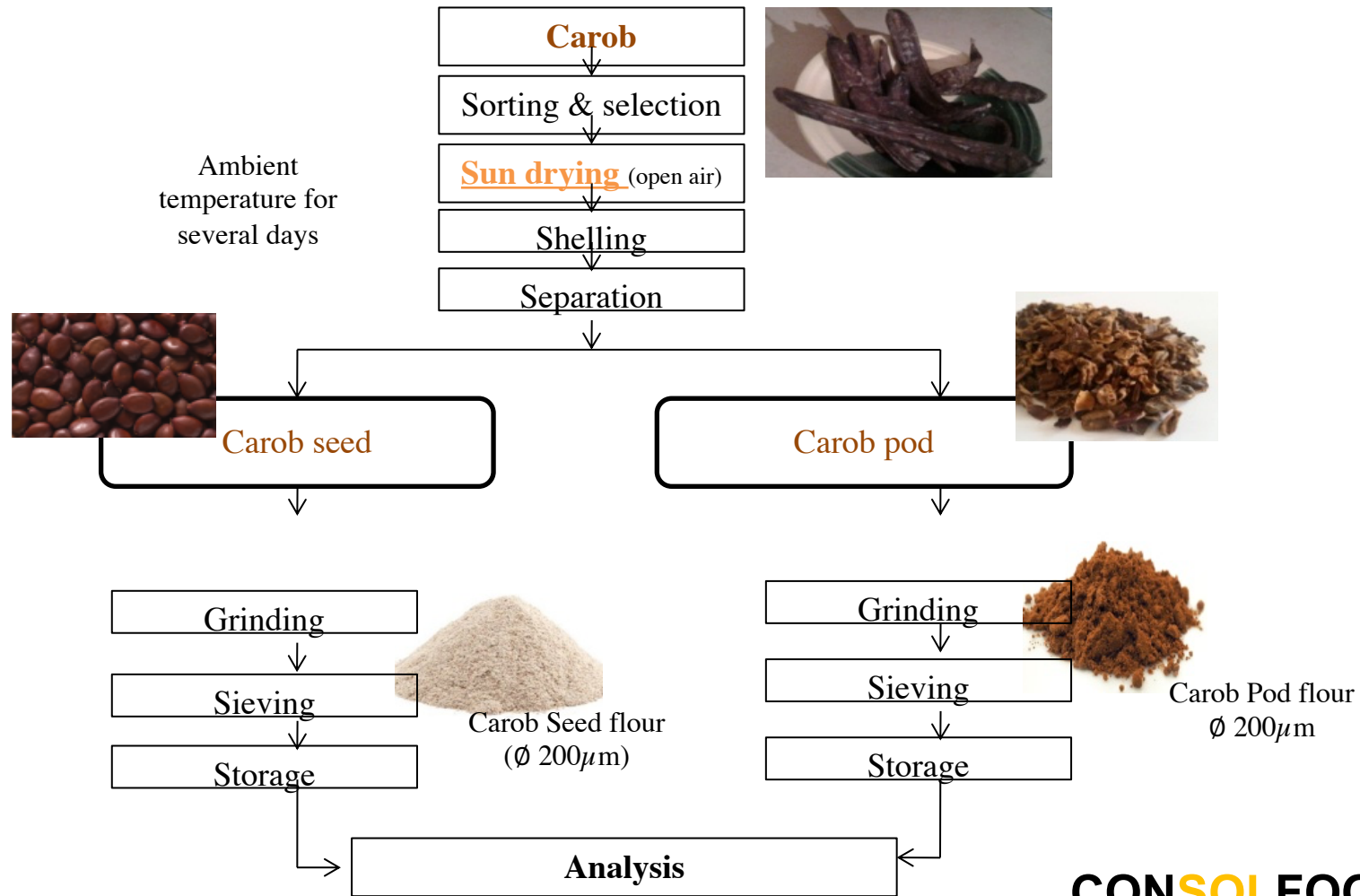
Fabacea family

Rich in sugars, fibers and minerals

Rich in polyphenols  
(health-promoting phytochemicals)



Innovative, sustainable  
bread & bakery products  
by blending carob flour  
with wheat flour



## Analysis:

Humidity (AACCI Approved Method 44–15.02)

Alveographic properties of dough (AACC 54-30, ICC 121, NF EN-ISO 27971, GOST 51415-99)

Instrumental analysis of colour and texture

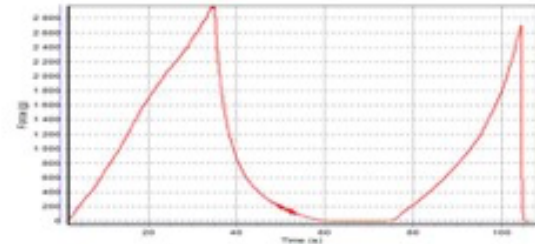
Ash (minerals), gluten content

Aroma profile (GC-MS)

Hedonic studies



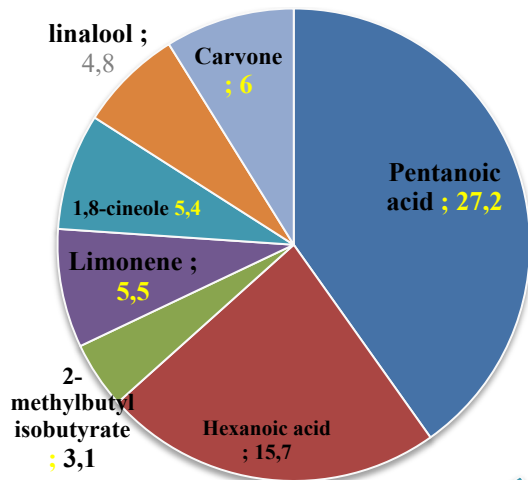
*Measuring colour and texture*



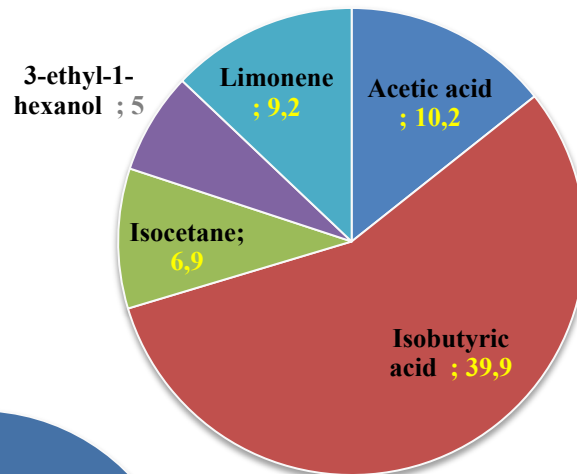
## Some Results

Samples		H (%)	P (mm)	L (mm)	G (cm <sup>3</sup> )	W (10 <sup>-4</sup> J)	P/L	Ie (%)
White flour		14.8	71.2	60.6	17.08	152	1.288	47.9
Carob pods powder	C100%	13.53	No rheological properties of carob pods flour					
	C30%	13.4	69.0	20,2	9,96	58	3,556	ND
	C20	13.5	89.6	30.8	12.28	119.4	2.82	ND
	C10	13.7	55.4	53.4	16.18	103.6	1.05	41.12
	C5%	14.3	67.4	38.2	13.7	104.4	1.782	ND
Carob seed powder	G100%	5.9	No rheological properties of carob seed flour					
	G10%	14.0	276.7	15.75	8.8	186.7	17.57	ND
	G5%	14.2	134.6	30.8	12.26	178.2	4.45	ND
Mixture WF x C x CS	M1	13.6	253.4	14.8	8.54	160.4	17.15	ND
	M2	13.2	164	14.4	8.4	97.2	12.63	ND

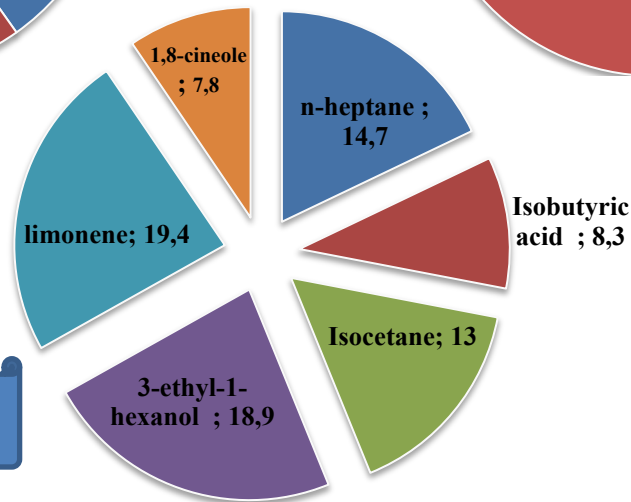
### Aromatic composition of carob (pod) flour



### Aromatic composition of carob seed flour



### Aromatic composition of wheat flour

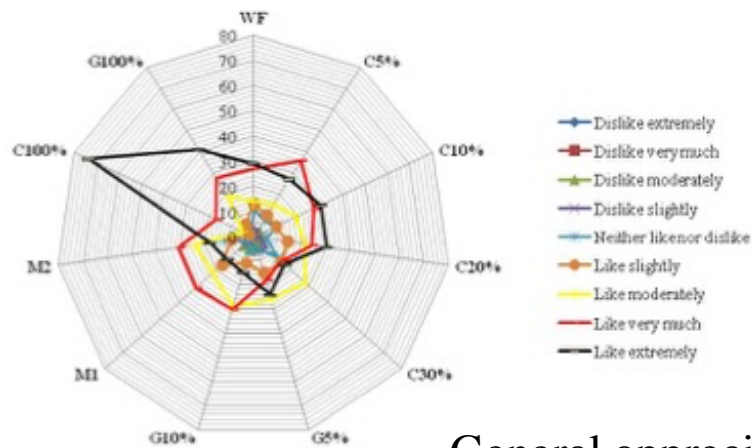




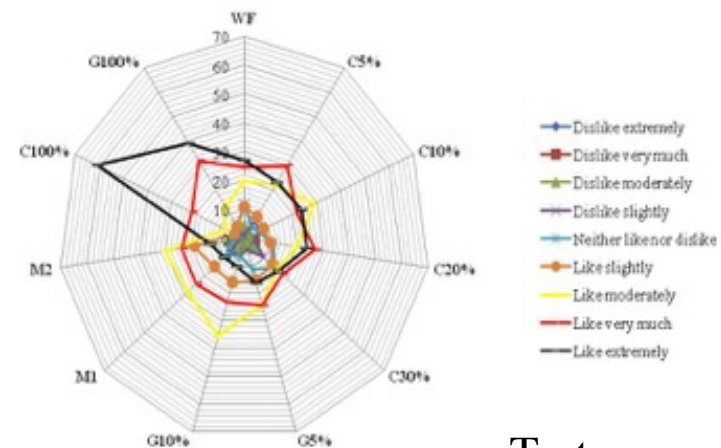
## Hedonic evaluation



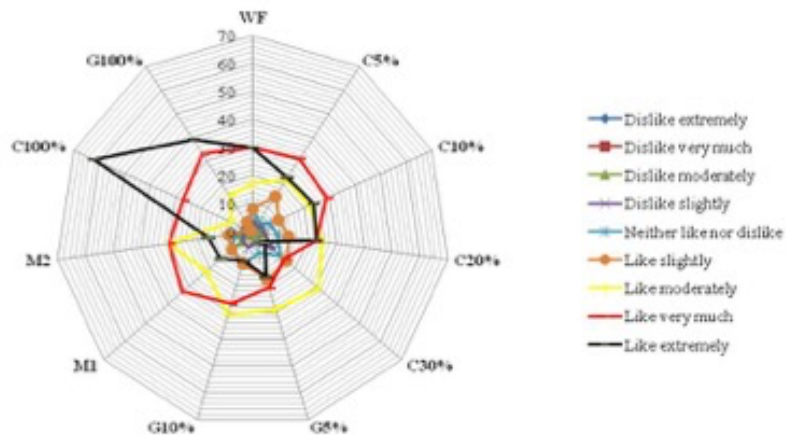




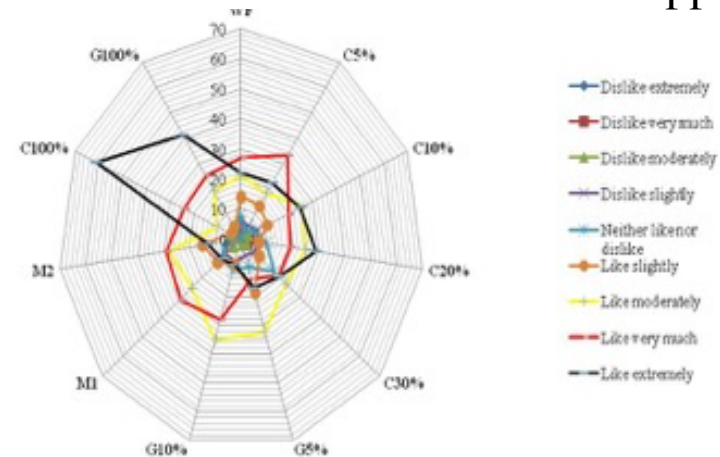
General appreciation



Taste appreciation



Texture appreciation



Odour appreciation

## In Conclusion,

### *Blending wheat flour with sun dried carob flour for sustainable and healthy bread and pastries*

- *Less use of energy to produce flour and hence lower C footprint of bread and pastries*
- *Higher anti-oxidant and free-radical scavenging activity*
- *Reduced gluten content and darker colour of bread are relevant for some niche markets*
- *Less furanic contaminants (from Maillard reactions) than those observed with white wheat flour*

The result of the hedonic study showed that the “tasters” liked very much the pastry products made from carob (the carob pulp cake (C100%) and the carob seed cake (G100%))

To crown the whole, carob is a typical Mediterranean product that enables the formulation of a wide diversity of sustainable foodstuffs of high nutritive value, low carbon footprint, safe, healthy, tasty and affordable, all at once.