Foods 2020
The 1st International Electronic Conference on Food Science and Functional Foods
10–25 NOVEMBER 2020 | ONLINE

NUTRITIONAL AND PHYSICOCHEMICAL CHARACTERIZATION OF VEGETABLE FIBRES IN ORDER TO OBTAIN GELLED PRODUCTS.

Ana Teresa Noguerol [1], Marta Igual [1] and Mª Jesús Pagán-Moreno [1]*

[1] Universitat Politècnica de València, Food Technology Department, Food Investigation and Innovation Group, Camino de Vera s/n, 46022 Valencia, Spain; annome@etsiamn.upv.es; marigra@upvnet.es; jpagan@tal.upv.es
* Correspondence: jpagan@tal.upv.es; Tel.: +34-963877000 ext. 73621

foods MDPI

1. INTRODUCTION

CONSUMERS INTEREST IN HEALTH
INCREASE

DEMAND MORE NATURAL AND LESS
PROCESSED FOOD

IMPORTANCE IN THE CONSUPTION
OF **DIETARY FIBRE** (DF)

DESIGNING FUTURE FOOD STRUCTURES
BY STRUCTURING FOOD COLLOIDS

OBJETIVE

The main purpose of this research was to evaluate the nutritional and physicochemical properties of two different combination of vegetable fibres and the possibility of using them as a thickener or gelling agent in food.

2. MATERIALS AND METHODS

Raw materials

Sample pictures

FBPC

Mix of bamboo, *Psyllium* and citric fibre.

FPESB

Mix of pea, cane sugar and bamboo fibre.

2. MATERIALS AND METHODS

Physicochemical analysis

Moisture (x_w) (g water/100 g sample) was determined by vacuum oven drying at 70°C until constant weight.

Water activity (a_w) of the samples was analysed by the AquaLab PRE LabFerrer equipment (Pullman, USA).

Hygroscopicity (Hg) was determined according to Cai, & Corke [5].

Samples **particle size distribution** was determined according to the ISO13320 normative (AENOR 2009) using a particle size analyser (Malvern Instruments Ltd., Mastersizer 2000, UK) equipped with a dry sample dispersion unit (Malvern Instruments Ltd., Scirocco 2000). The particle size distribution was characterized by the volume mean diameter (D [4.3]).

The **porosity (ε)** was determined from the true (ρ) and **bulk (ρ_b) densities** according to Agudelo et al. [6] with slight modifications.

2. MATERIALS AND METHODS

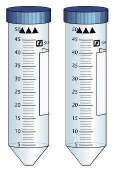
Hydration properties

Water-holding capacity (WHC) and **water retention capacity** (WRC) was described by Raghavendra et al. [7] and Chantaro et al. [8], respectively.

WRC with centrifugation
WHC without centrifugation

Samples

add water

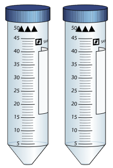


Hydrated 18 h → WHC / WRC → Dry hydrated residues 100°C until constant weight

Swelling water capacity (SWC) and **fat adsorption capacity** (FAC) was described by Navarro-González et al. [9] with minor modifications.

Samples

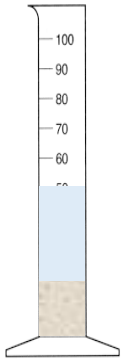
add oil



Hydrated 30 min → FAC → Decant oil and weight

add water

Samples →



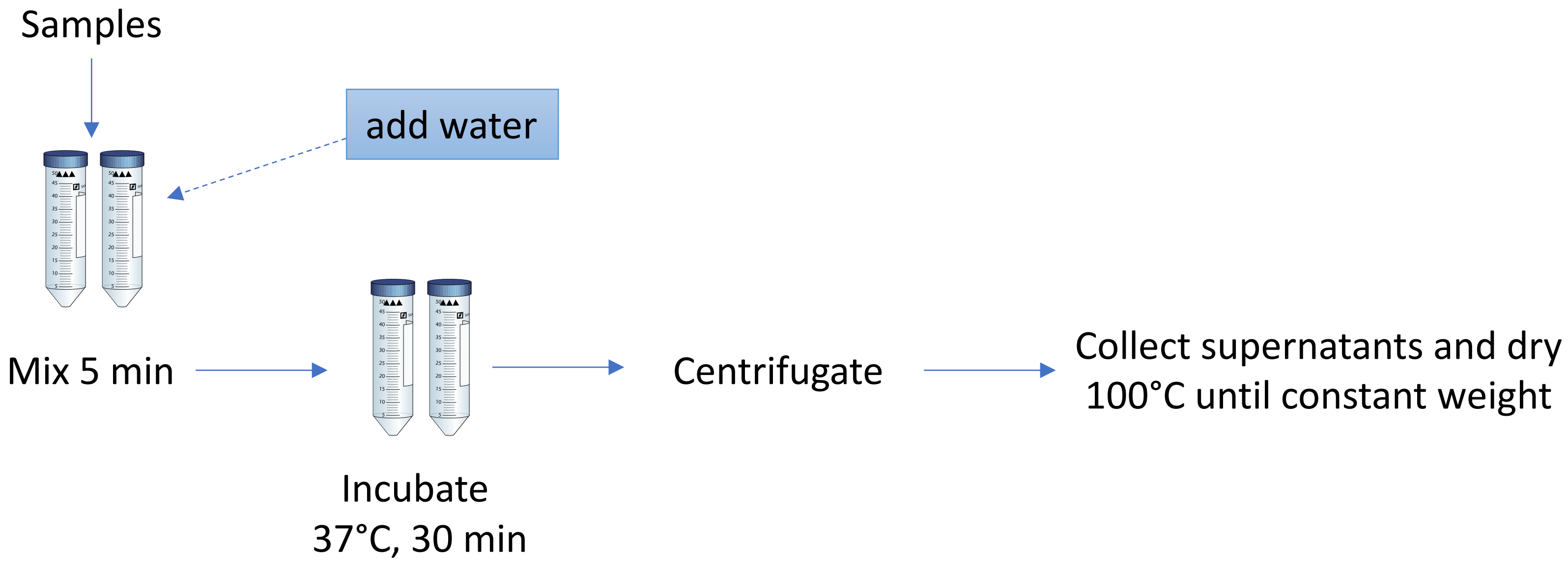
→ Record the bed volume (SWC)

Hydrated 18 h

2. MATERIALS AND METHODS

Hydration properties

Water solubility index (WSI) was analysed according to the method of Mahdavi et al. [10] with small modifications.



2. MATERIALS AND METHODS

Antioxidant capacity and Phenolic compounds

Antioxidant capacity (AOA) was assessed using DPPH method following Igual et al. [11] methodology.

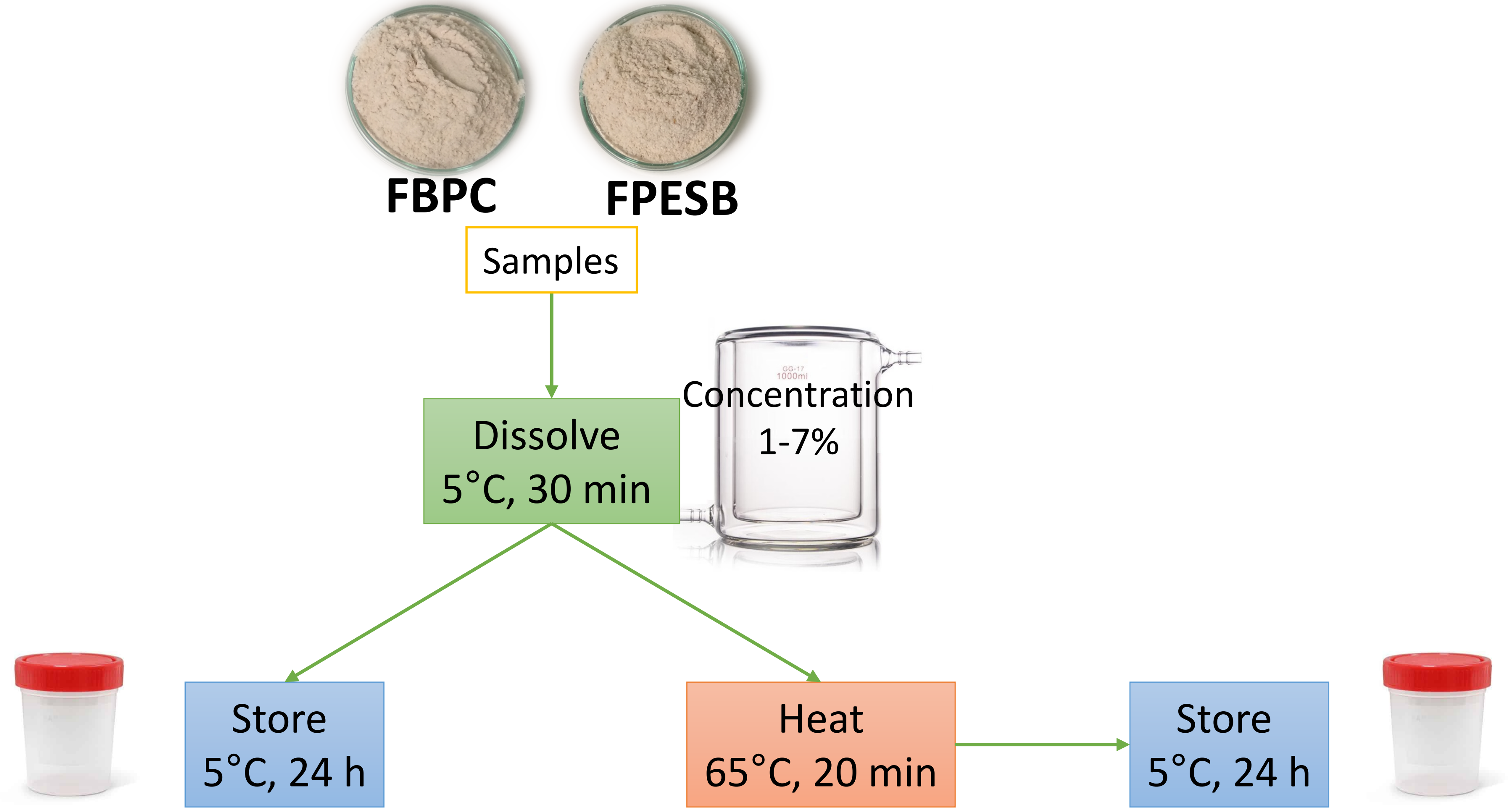
Total phenol content (PC) was carried out according to Agudelo et al. [6].

Mineral analysis

The **multi-mineral determination** was analysed using inductively coupled plasma optical emission spectrometer, model 700 Series ICP-OES from Agilent Technologies (Santa Clara, United States), with axial viewing and a charge coupled device detector [12]. Mineral composition (macro and microelements) were expressed as mg/100 g.

2. MATERIALS AND METHODS

Gel preparation



2. MATERIALS AND METHODS

Gel analysis

The **pH** of the gel samples was measured using a pH-meter Crison MultiMeter MM 41 (Hach Lange, Spain).

To determine the **colour** of the gel's translucency and CIE*L*a*b* colour were carried out according to García-Segovia et al. [12].

Textural characteristics were evaluated by using a TA-XT2 Texture Analyser (Stable Micro Systems Ltd, Godalming, UK). **Back extrusion test** was performed following the method described by Cevoli et al. [13] with minor modifications

3. RESULTS AND DISCUSSION

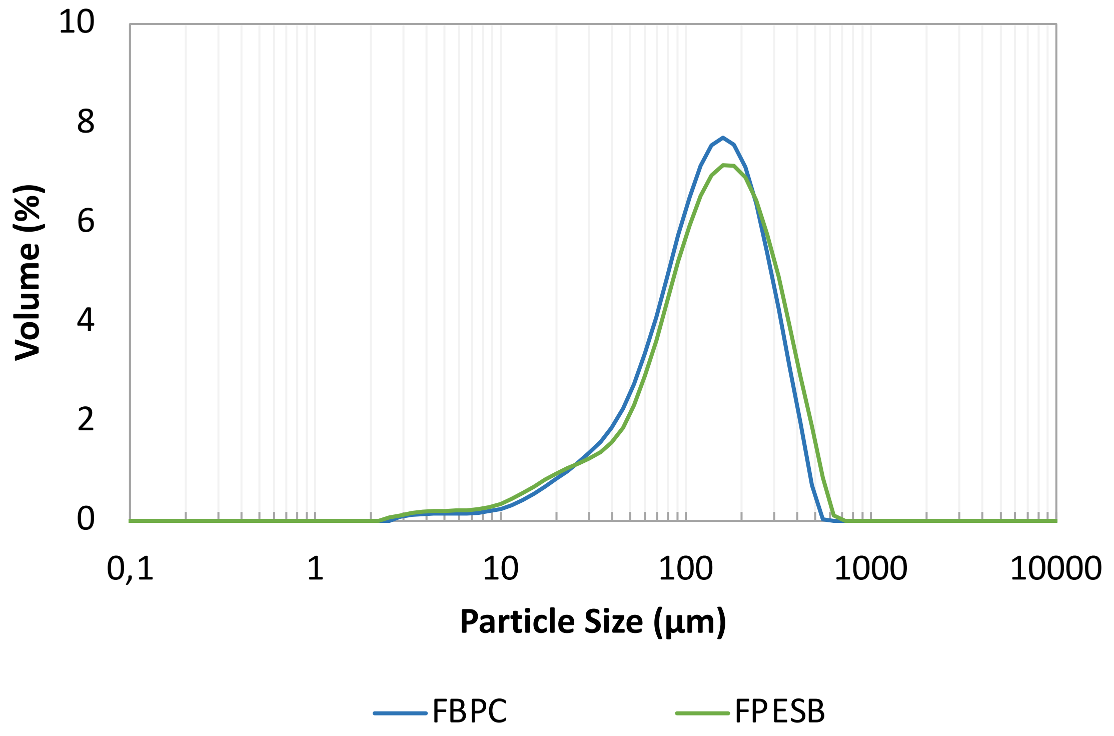
Physicochemical results of DFs

Volume mean diameter (D[4,3])

	D[4,3] (µm)
FBPC	142.6 ± 0.3 [b]
FPESB	156 ± 2[a]

Similar particle size distribution but high volume mean diameter for FPESB.

Volume of particle size distributions (representative curves) of fibres studied



3. RESULTS AND DISCUSSION

Physicochemical results of DFs

Physicochemical properties of fibres tested

	Samples	
	FBPC	**FPESB**
Moisture (%)	6.676 ± 0.104[a]	5.7 ± 0,3[b]
Water activity (a_w)	0.3590 ± 0.0012[a]	0.342 ± 0.002[b]
Hg (g water/100 g dry solid)	26.7 ± 0.7[a]	27.3 ± 0.2[a]
Bulk density (g/L)	489 ± 17[a]	354 ± 10[b]
Porosity	69.22 ± 0.95[b]	77.51 ± 0.12[a]

3. RESULTS AND DISCUSSION

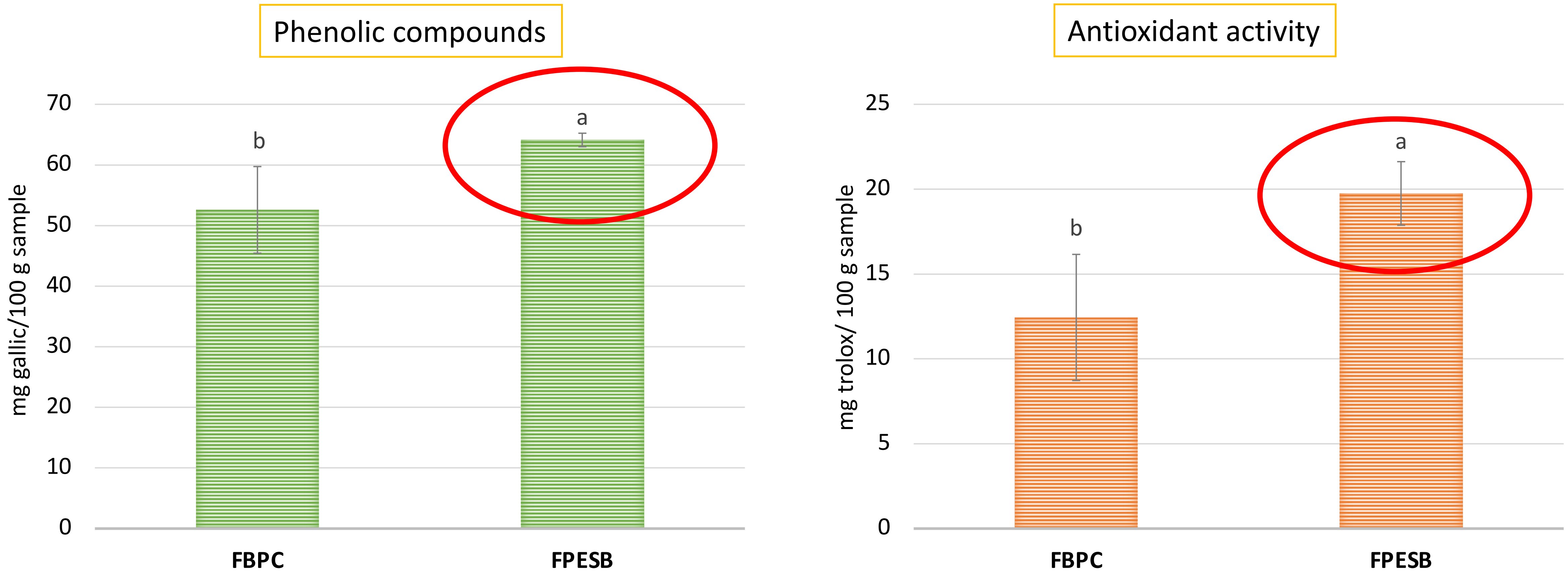
Hydration properties of DFs

Hydration properties of fibres tested

	Mix of vegetable fibres	
	FBPC	FPESB
WHC (g water/g sample)	21.197 ± 0.097[a]	6.18 ± 1.03[b]
WRC (g water/g sample)	8.7 ± 0.8[a]	4.9 ± 0.3[b]
SWC (mL water/g sample)	8 ± 2[a]	9.2 ± 0.8[a]
FAC (g oil/g sample)	1.44 ± 0.03[b]	1.91 ± 0.03[a]
WSI (%)	19.4 ± 0.2[a]	6.28 ± 0.02[b]

3. RESULTS AND DISCUSSION

Functional results of DFs



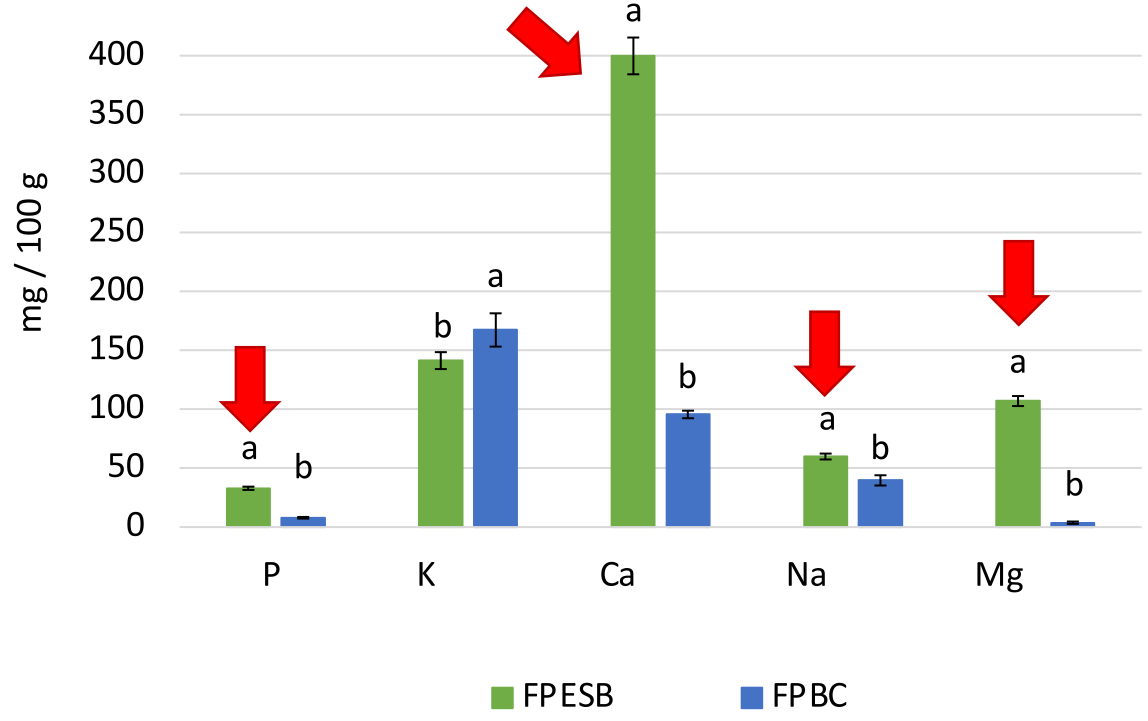
FPESB showed grater functional properties

3. RESULTS AND DISCUSSION

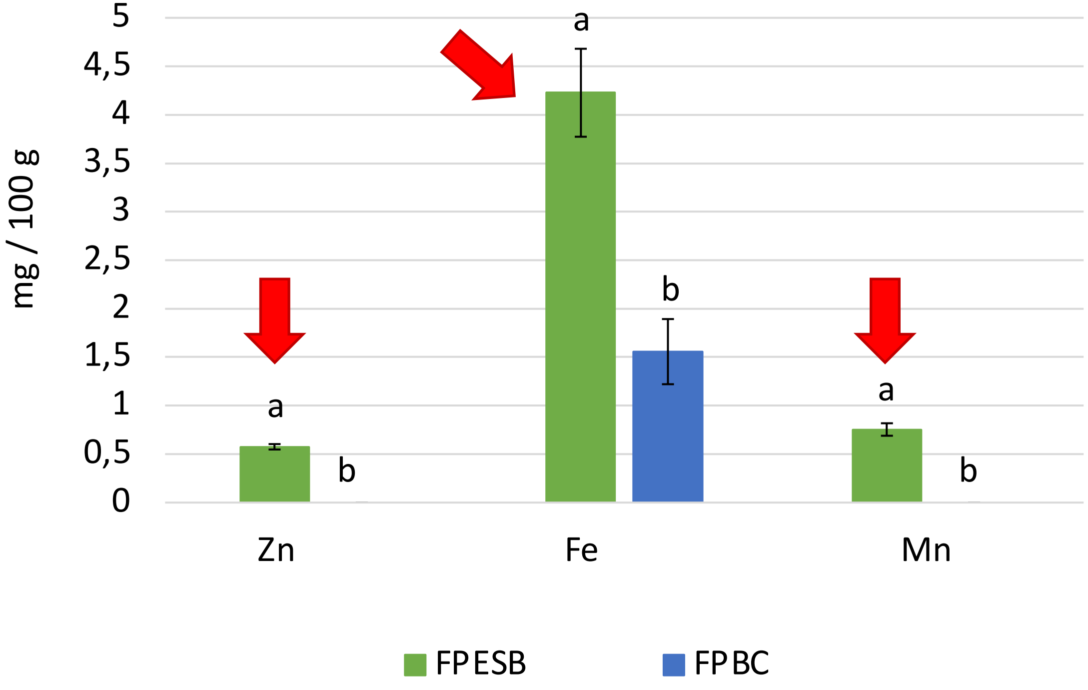
Nutritional results of DFs

Mineral content of samples expressed in mg/100g

Macro elements



Microelements

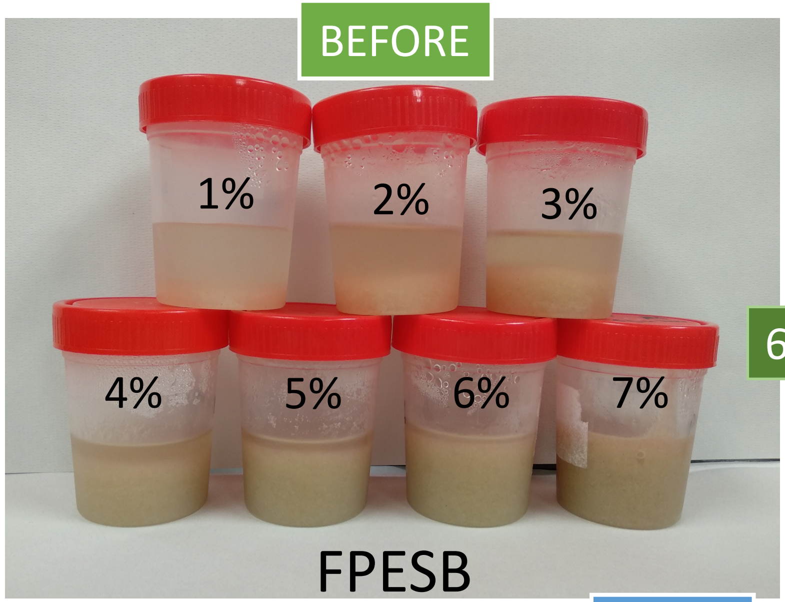


FPESB showed a higher mineral content

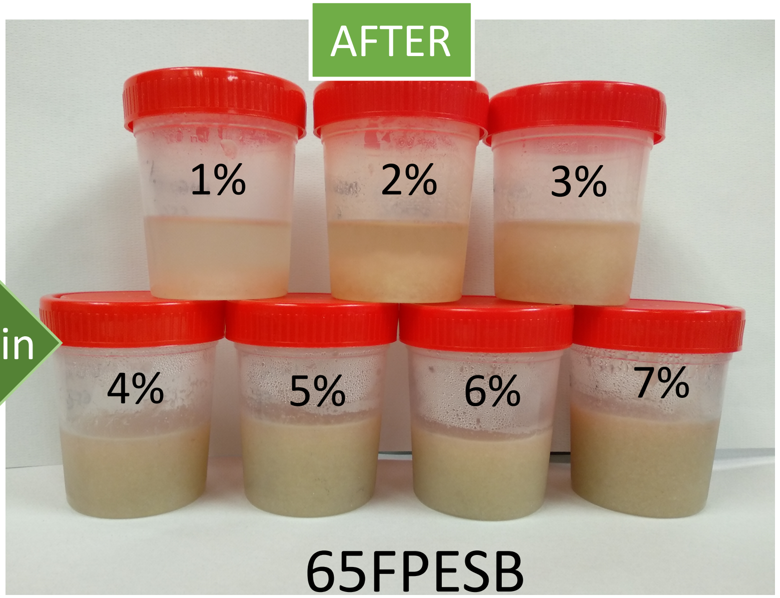
3. RESULTS AND DISCUSSION

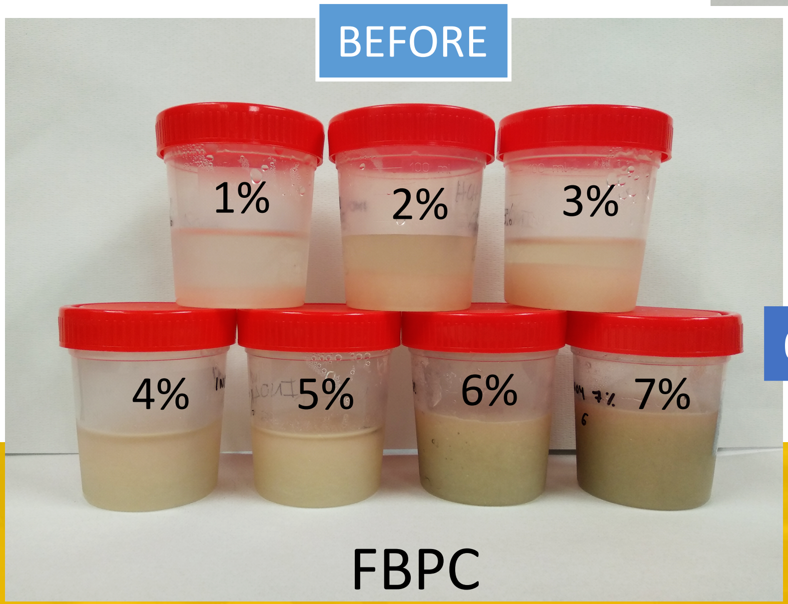
Gel analysis results

Pictures of samples before and after to be heated at 65ºC during 20 min

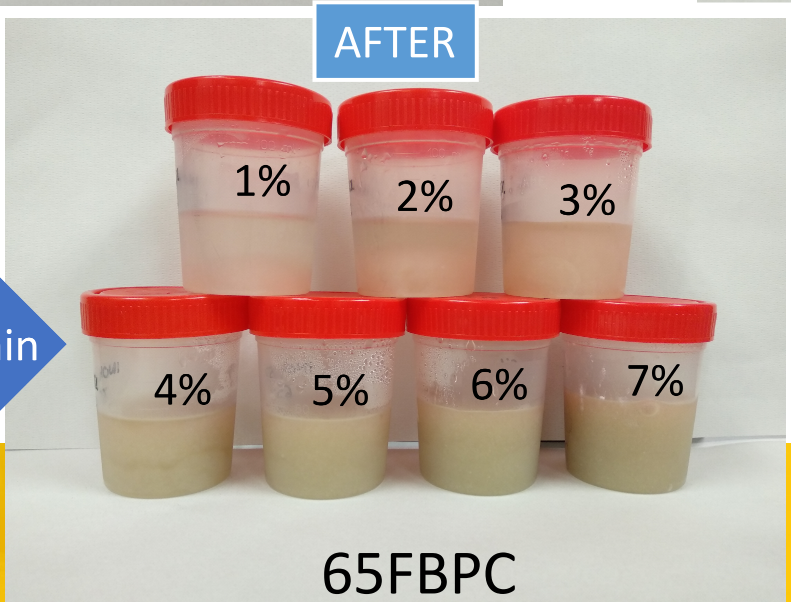


65ºC 20 min





65ºC 20 min



3. RESULTS AND DISCUSSION

Gel analysis results

Sample	C (%)		pH	L*	a*	b*	Consistency (Ns)	Firmness (N)	Viscosity (Ns)	Cohesiveness (N)
FBPC	1	+	6.90 ± 0.02^{aB}	11 ± 2^{iI}	-0.16 ± 0.05^{ghiDE}	-0.9 ± 0.3^{gJ}	1.006 ± 0.013^{hF}	0.187 ± 0.003^{hF}	0.054 ± 0.002^{gG}	0.143 ± 0.007^{gH}
	2		6.7 ± 0.3^{cD}	13.4 ± 0.7^{hG}	-0.13 ± 0.04^{ghCD}	0.47 ± 0.13^{fG}	1.02 ± 0.02^{hF}	0.1912 ± 0.0103^{hF}	0.057 ± 0.005^{gG}	0.158 ± 0.012^{gH}
	3		6.22 ± 0.03^{eF}	14 ± 0.5^{ghG}	-0.23 ± 0.02^{iF}	-0.470 ± 0.098^{gH}	1.884 ± 0.102^{ghF}	0.377 ± 0.019^{ghF}	0.221 ± 0.014^{fgG}	0.30 ± 0.04^{gH}
	4		6.09 ± 0.06^{fG}	17.0 ± 0.2^{fF}	-0.21 ± 0.03^{hiEF}	0.43 ± 0.08^{fG}	6.5 ± 0.5^{fEF}	1.267 ± 0.106^{fgEF}	0.71 ± 0.05^{eF}	1.05 ± 0.04^{fG}
	5		5.98 ± 0.02^{gI}	20.3 ± 0.4^{eE}	-0.118 ± 0.009^{gCD}	0.77 ± 0.12^{fF}	12.4 ± 1.5^{eE}	2.2 ± 0.3^{efE}	1.33 ± 0.07^{dE}	1.911 ± 0.096^{eF}
	6		5.99 ± 0.07^{gI}	26.7 ± 0.5^{cB}	0.10 ± 0.05^{fB}	2.78 ± 0.13^{eC}	27 ± 3^{cD}	4.7 ± 0.4^{cD}	2.26 ± 0.15^{cD}	3.22 ± 0.13^{dE}
	7	-	5.9 ± 0.5^{iJ}	28.0 ± 0.4^{bcA}	$0.19 \pm 0.03e^{A}$	3.43 ± 0.15^{cdA}	42 ± 8^{aC}	8 ± 2^{aC}	3.6 ± 0.5^{bC}	5.5 ± 0.7^{bC}
65FBPC	1	+	7.16 ± 0.02^{zA}	12 ± 2^{qHI}	-0.16 ± 0.05^{vDE}	-0.8 ± 0.2^{sIJ}	1.05 ± 0.02^{sF}	0.1902 ± 0.0112^{sF}	0.054 ± 0.003^{tG}	0.149 ± 0.002^{tH}
	2		6.8 ± 0.3^{yC}	13 ± 2^{rqGH}	-0.15 ± 0.06^{vD}	-0.4 ± 0.2^{sH}	2.28 ± 0.18^{sF}	0.73 ± 0.03^{tsF}	0.149 ± 0.015^{tG}	0.2200 ± 0.0115^{tH}
	3		6.28 ± 0.03^{vF}	13.5 ± 0.5^{rG}	-0.26 ± 0.03^{uF}	-0.54 ± 0.13^{sHI}	9.6 ± 0.3^{tsEF}	1.800 ± 0.110^{tsEF}	0.70 ± 0.03^{uF}	1.00 ± 0.07^{uG}
	4		6.05 ± 0.05^{uG}	21.51 ± 1.18^{vuE}	-0.11 ± 0.04^{vCD}	1.6 ± 0.4^{uE}	24 ± 2^{uD}	4.5 ± 0.6^{vD}	1.3 ± 0.2^{vE}	2.21 ± 0.16^{vF}
	5		5.97 ± 0.02^{tI}	23.0 ± 0.7^{vD}	-0.08 ± 0.07^{vC}	2.2 ± 0.3^{vD}	39 ± 6^{vC}	7 ± 2^{wC}	2.20 ± 0.17^{wD}	4.0 ± 0.4^{wD}
	6		5.97 ± 0.06^{tsI}	25.3 ± 0.2^{wC}	0.06 ± 0.02^{wB}	3.1 ± 0.2^{wB}	75 ± 13^{xB}	14 ± 2^{yB}	4.3 ± 0.5^{xB}	8.0 ± 0.9^{yB}
	7	-	5.9 ± 0.5^{rJ}	28.1 ± 0.3^{yxA}	0.1060 ± 0.0114^{wB}	3.53 ± 0.13^{wA}	107 ± 21^{zA}	20 ± 4^{zA}	6.0 ± 0.6^{yA}	10.4 ± 1.3^{zA}
FPESB	1	+	6.8 ± 0.2^{bZ}	9 ± 3^{jS}	0.226 ± 0.104^{eV}	0.8 ± 0.6^{fS}	0.97 ± 0.03^{hT}	0.176 ± 0.007^{hT}	0.052 ± 0.007^{gU}	0.1486 ± 0.0115^{gU}
	2		6.33 ± 0.04^{dX}	15 ± 2^{gU}	0.64 ± 0.14^{cY}	3.1 ± 0.6^{deU}	0.99 ± 0.03^{hT}	0.171 ± 0.006^{hT}	0.052 ± 0.008^{gU}	0.142 ± 0.008^{gU}
	3		6.10 ± 0.08^{fW}	22.2 ± 0.3^{dW}	0.66 ± 0.05^{cY}	3.7 ± 0.3^{cV}	1.23 ± 0.12^{hUT}	0.47 ± 0.17^{ghT}	0.057 ± 0.003^{gU}	0.1548 ± 0.0105^{gU}
	4		5.93 ± 0.02^{hV}	22.1 ± 0.8^{dW}	0.45 ± 0.04^{dX}	3.23 ± 0.08^{dVU}	5.7 ± 0.7^{fgVU}	1.274 ± 0.103^{fgUT}	0.49 ± 0.06^{efV}	0.92 ± 0.19^{fV}
	5		5.76 ± 0.02^{jT}	27.2 ± 0.4^{cX}	0.67 ± 0.07^{cY}	4.6 ± 0.3^{bXW}	14 ± 6^{deW}	2.5 ± 0.8^{deV}	1.3 ± 0.2^{dW}	2.1 ± 0.4^{eW}
	6		5.67 ± 0.02^{kR}	29.2 ± 0.5^{abY}	0.81 ± 0.09^{bZ}	5.0 ± 0.3^{aYX}	16.9 ± 0.7^{dW}	3.204 ± 0.115^{dWV}	2.4 ± 0.2^{cX}	3.73 ± 0.14^{cX}
	7	-	5.65 ± 0.02^{kR}	30.6 ± 0.2^{aZY}	0.89 ± 0.03^{aZ}	5.2 ± 0.3^{aY}	36 ± 6^{bX}	6.6 ± 1.5^{bX}	4.2 ± 0.6^{aY}	6.2 ± 0.6^{aY}
65FPESB	1		6.7 ± 0.2^{xY}	13 ± 2^{rqT}	-0.13 ± 0.08^{vT}	0.5 ± 0.3^{tS}	0.99 ± 0.02^{sT}	0.177 ± 0.006^{sT}	0.054 ± 0.004^{tU}	0.145 ± 0.012^{tU}
	2	+	6.32 ± 0.04^{wX}	17 ± 2^{sU}	0.10 ± 0.05^{wU}	2.1 ± 0.7^{vT}	1.5 ± 0.3^{sUT}	0.43 ± 0.07^{sT}	0.070 ± 0.004^{tU}	0.161 ± 0.007^{tU}
	3		6.08 ± 0.05^{uW}	19 ± 2^{tV}	0.4 ± 0.2^{xXW}	2.5 ± 0.5^{vT}	8.2 ± 0.8^{sV}	2.32 ± 0.19^{utVU}	0.80 ± 0.06^{uV}	1.0 ± 0.2^{uV}
	4		5.93 ± 0.03^{sV}	20.2 ± 0.7^{utV}	0.33 ± 0.05^{xW}	2.5 ± 0.3^{vT}	18 ± 2^{utW}	3.7 ± 0.4^{vuW}	1.24 ± 0.18^{vW}	1.8 ± 0.3^{vW}
	5		5.85 ± 0.04^{qU}	26.7 ± 0.4^{xwX}	0.60 ± 0.03^{yY}	4.28 ± 0.07^{xW}	38 ± 5^{vX}	7.01 ± 1.04^{wX}	2.4 ± 0.3^{wX}	3.8 ± 0.4^{wX}
	6		5.77 ± 0.02^{pT}	29.1 ± 0.4^{yY}	0.81 ± 0.05^{zZ}	5.0 ± 0.2^{yYX}	63 ± 3^{wY}	12.08 ± 1.12^{xY}	4.5 ± 0.9^{xY}	6.4 ± 0.3^{xY}
	7	-	5.72 ± 0.02^{oS}	31.6 ± 0.5^{zZ}	0.88 ± 0.06^{zZ}	5.8 ± 0.2^{zZ}	94 ± 9^{yZ}	19 ± 2^{zZ}	7.3 ± 0.4^{zZ}	10.1 ± 0.4^{zZ}

4. CONCLUSIONS

In short, the physicochemical, functional and nutritional properties of both combinations of vegetable fibres, as well as their ability to form gels, make it possible to use them to modify the texture of different foods and provide the benefits of DF consumption.

5. OBSERVATIONS

Due to the length of the proceeding paper, it has not been possible to develop and expose the results obtained properly, since in this study all the parameters obtained could be discussed and related in more depth.

Thanks for you attention