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Functional ingredients based on Jerusalem artichoke: technological properties, antioxidant activity, and prebiotic capacity

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INTRODUCTION & AIM

Tubers of Jerusalem artichoke (*Helianthus tuberosus* L.) contain nearly 20% (w/w) of reserve carbohydrates as fructans, mainly inulin (70–90% w/w), a soluble fiber with prebiotic activity. For this reason, it can be considered as a potential ingredient for functional foods formulation.

The study aims to utilize whole tubers from Jerusalem artichoke (JA) for functional ingredient production as an alternative to extractive methods for inulin recovery, thereby maximizing its nutritional value.

METHODS

Jerusalem Artichoke tubers (JA) where harvested from a farm where organic crop trials were carried out (Villa Regina, Río Negro, Patagonia Argentina). Tubers were washed, brushed and disinfected 20 min in NaOCl solution (280 ppm), and rinsed 10 min with distilled water. Water was drained, their excess was removed with tissue paper and tubers were stored in bags at 0°C until use.

Process to obtain JA powders (JAP)

Filleted → Pretreatment → Dehydration → Milling → Sieved → Ingredients

Pretreatment:
- water immersion **(W)**
- pressing (3 cycles of 5, 10, and 13 tn, 1 min) with citric acid dip pH=3.5 **(P)**

Dehydration:
- air-drying at 60ºC, 8% HR **(A)**
- freeze-drying at -84ºC, 0.22 mbars, 48 h **(F)**

Sieved: No. 70 ASTM

Ingredients: JAPWA, JAPWF, JAPPA, JAPPF

Determinations
- Technological properties, including the water holding capacity (WHC), water binding (WBC), swelling (SC), and oil absorption (OAC)
- Inulin by HPLC, phenolic (P), and flavonoid (F) content
- *In vitro* prebiotic activity score (PAS)
- Antioxidant capacity by ABTS+˙ and FRAP methods

RESULTS & DISCUSSION

Technological properties

Ingredients	Factors: Pretreatment (T)	Factors: Drying method (D)	WHC g water/g dm	WBC g water/g dm	OAC g oil/g dm	SC ml/g dm
JAPWA	W	A	$6.0\pm0.1^{A,b}$	$2.7\pm0.1^{A,b}$	$1.6\pm0^{A,a}$	$6.1\pm0.2^{A,b}$
JAPPA	P	A	$6.8\pm0.5^{A,b}$	$3.1\pm0.3^{B,b}$	$1.6\pm0^{B,a}$	$7.5\pm0.2^{A,b}$
JAPWF	W	F	$4.7\pm0.1^{A,a}$	$2.0\pm0.1^{A,a}$	$2.0\pm0.1^{A,b}$	$4.9\pm0.3^{A,a}$
JAPPF	P	F	$3.9\pm0.3^{A,a}$	$2.0\pm0.1^{B,a}$	$2.1\pm0.1^{B,b}$	$4.1\pm0.1^{A,a}$
Interaction T*D			N. sig.	N. sig.	N. sig.	N. sig.

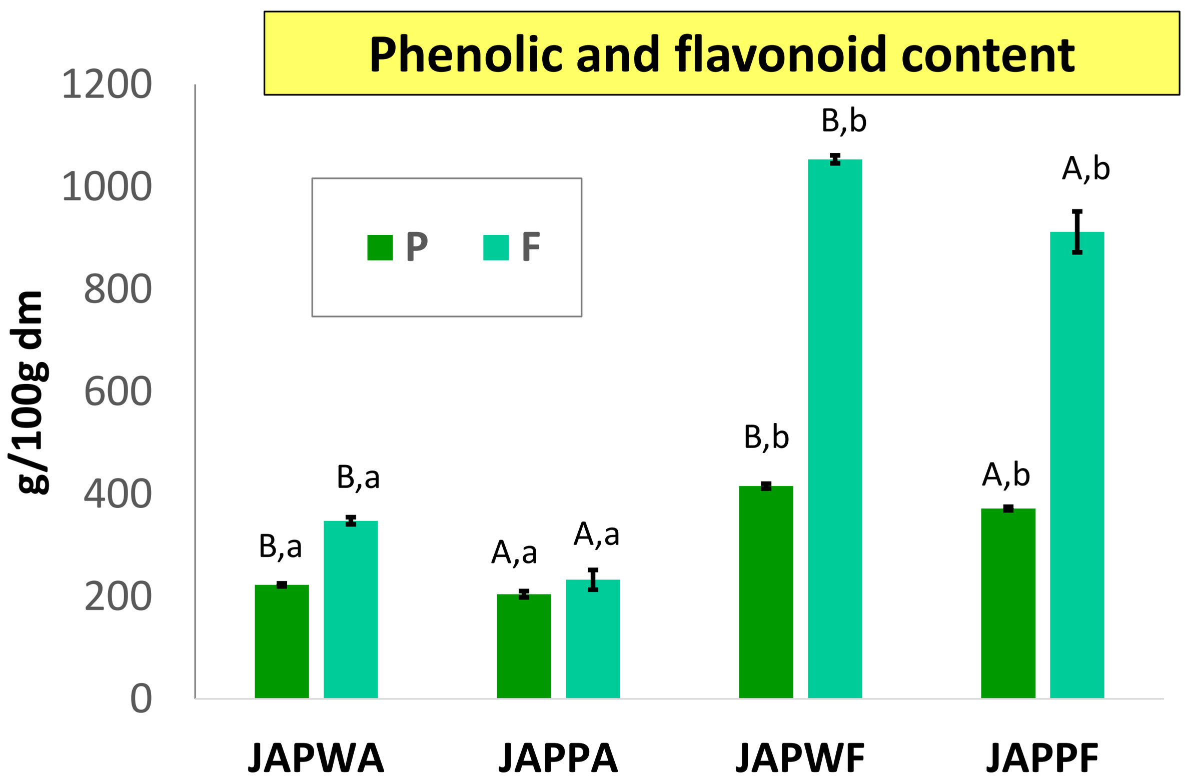
The air-dried powders exhibited the highest WHC, WBC, and SC, whereas the freeze-dried ones presented the greatest OAC ($p<0.05$).

Inulin content and PAS

P pretreatment favored inulin retention (61±3 g/100g dm), while the effect of "drying method" factor was not significant ($p<0.05$).
PAS presented main effect of factors P and D. Pressing and freeze-drying conducted to ingredients with higher PAS. Differences in the prebiotic activity could be attributed firstly a higher inulin content in P powders, and secondly to the polyphenols influence, since freeze-dried powders presented more than twice the polyphenol content of air-dried powders (400±5 vs. 193±6 mg AGE/100g dm).

Ingredients	Factors: Pretreatment (T)	Factors: Drying method (D)	Inulin content (g/100 g dm)	PAS
JAPWA	W	A	$56\pm0.2^{A,a}$	$0.58\pm0.05^{A,a}$
JAPPA	P	A	$61\pm3^{B,a}$	$0.82\pm0.05^{B,a}$
JAPWF	W	F	$54\pm1.5^{A,a}$	$0.93\pm0.15^{A,b}$
JAPPF	P	F	$60\pm1^{B,a}$	$1.12\pm0.08^{B,b}$
Interaction T*D			N. sig	N. sig

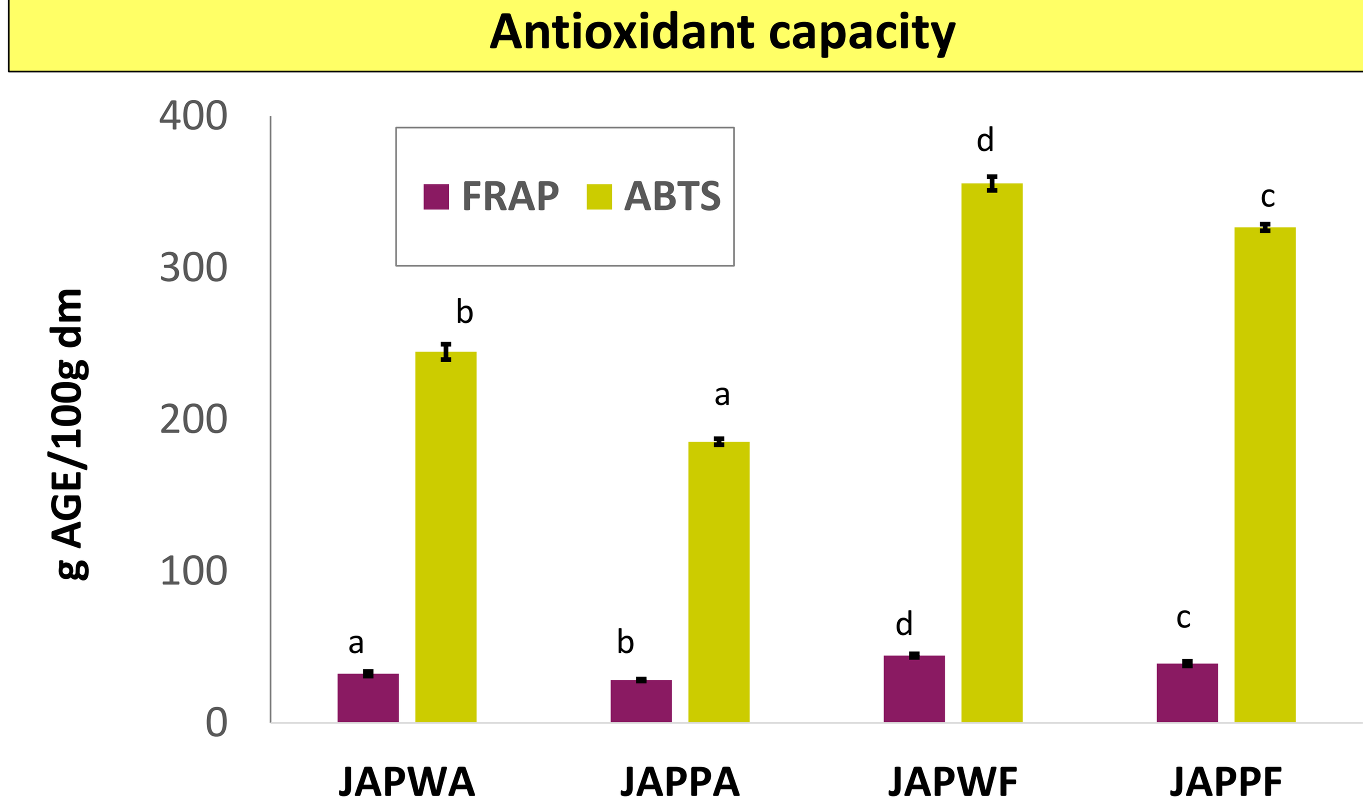
Phenolic and flavonoid content



Bioactive compounds: Main effects of the factors studied on the content of polyphenols and flavonoids were observed.
P and F were lost during the pressing pretreatment, while freeze-drying favored their retention.

ABTS+˙ and FRAP: the factors under study showed a significant interaction, with JAPWF having the highest antioxidant capacity.

Antioxidant capacity



CONCLUSION

The ingredients obtained in the present work presented potential functional. Particularly, JAPPA exhibited better technological properties, providing higher inulin content and prebiotic capacity than JAPWA, making it a cost-effective alternative for producing functional JAP with applicability in food matrices such as baked goods.