VALORIZATION OF DATE FRUIT BY-PRODUCTS AS LOW-COST NATURAL ANTIOXIDANT FOR MEAT INDUSTRY

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I. INTRODUCTION

Date palm is the most successful and one of the most important subsistence crops in many hot, arid regions [1]. During production, substantial loss of fruit, namely “by-products,” occurs. These raw materials have an important content of natural bioactive molecules, such as antioxidants, polyphenolic compounds, and vitamins, and have gained relevance for their beneficial effects on health and applications in the food industry. Currently, consumers increasingly value and recognize “health-promoting components” [2]. Particularly, the meat industry faces a challenge because of the association of meat products with the development of chronic degenerative diseases. Thus, the meat industry has searched for new approaches that could mitigate this problem. Alternative methods such as adding phytochemicals in meat products have been proposed [3]. Fruits and their by-products, such as skin, pulp, and seeds, ubiquitously contain bioactive molecules; for this reason, their use is one means of adding value to and innovating traditional meat products. The objective of this study was to evaluate the antioxidant potential of date by-product extracts as additives for use in meat and meat products.

II. MATERIALS AND METHODS

The by-products (Khalal stage) and commercial fruit (Tamar stage) of two samples of date fruit (Medjool cultivar) from Sonora, Mexico, were evaluated. Fruits were inspected and selected to be free of damages and insects. Next, different fruit extracts were prepared using ultrasound assisted extraction (UAE) for 60 min. Water, acetone:water (70:30 v/v), methanol:water (50:50 v/v), and ethanol:water (50:50 v/v) were used as solvents for extraction (1:10, sample:solvent). Raw dry extracts were obtained and subsequently lyophilized and stored (-20 ºC). Phytochemical and antioxidant activity were evaluated according to total phenolic content (TPC) [4], total flavonoid content (TFlvC) [5], $ABTS^{+}$, $DPPH^{+}$ [6,7], and reducing power [8]. The first stage of data analysis was performed using a two-way linear model (GLM-ANOVA) (NCSS, 2011). All tests were considered statistically significant at $p<0.05$, and significant differences were further identified with Tukey-Kramer range tests.

III. RESULTS AND DISCUSSION

The by-product extracts obtained with different solvents showed differences ($p<0.05$) in phytochemical content and antioxidant activity, as follows: acetone>methanol>ethanol>water (Table 1). However, the extract obtained of date fruit commercial did not show differences ($p>0.05$). The by-product extract had a higher phytochemical content than commercial fruit. This is likely due to the drastic changes that dates of the Medjool variety undergo during maturation; the mayor activity of polyphenol oxidase during this process was also evidenced by our results [1]. Because of the chemical nature of fruit phenolics (that differ

from simple to highly polymerized forms), it is very important to explore different solvent extractions to discover specific class compounds that may be suitable for technological processes [9].

Table. 1 Phytochemical and antioxidant activity of date fruit extracts.

Solvent	TPC*	TFlvC**	ABTS***	DPPH***	RP****
			Date fruit co-product (Khalal)		
Acetone	22.09 ± 0.77^{a}	27.72 ± 1.75^{a}	80.01 ± 4.08^{a}	89.38 ± 5.62^{a}	0.42 ± 0.02^{a}
Methanol	16.52 ± 0.73^{b}	22.97 ± 0.51^{b}	71.84 ± 5.44^{b}	90.49 ± 5.77^{a}	0.30 ± 0.01^{b}
Ethanol	16.86 ± 1.0^{b}	23.28 ± 0.51^{b}	71.29 ± 4.26^{b}	89.83 ± 3.47^{a}	0.29 ± 0.01^{b}
Water	12.37 ± 0.90^{c}	21.34 ± 0.79^{d}	61.78 ± 7.13^{c}	90.38 ± 5.97^{a}	0.26 ± 0.01^{c}
			Date fruit commercial (Tamar)		
Acetone	4.26 ± 0.78^{a}	16.46 ± 0.23^{a}	16.74 ± 2.85^{a}	74.09 ± 4.58^{a}	0.13 ± 0.007^{b}
Methanol	3.53 ± 0.24^{a}	16.33 ± 0.55^{a}	14.53 ± 1.88^{b}	68.41 ± 3.24^{a}	0.18 ± 0.008^{a}
Ethanol	4.48 ± 0.47^{a}	16.35 ± 0.51^{a}	15.19 ± 1.60^{a}	68.02 ± 3.69^{a}	0.13 ± 0.003^{b}
Water	4.24 ± 0.45^{a}	16.30 ± 0.71^{a}	14.85 ± 2.06^{b}	73.75 ± 2.99^{a}	0.17 ± 0.003^{a}

Results are expressed as means ± standard deviation.
Values with a different letter within the column (co-product or commercial fruit extract) are significantly different ($p<0.05$).
*Expressed as mg gallic acid equivalents (GAE) per 100 g.
**Expressed as mg rutin equivalents (RE) per 100 g.
*** Expressed as inhibition percentage.
****Increased absorbance (0–1) of the reaction mixture indicates an increase in reducing power.

IV. CONCLUSION

Extracts from date fruit by-products, particularly Khalal, are appropriate for use as a new, low-cost food additive for innovating traditional meat products, especially because of their important content of phytochemicals that can be used in meat and meat products susceptible to oxidation.

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