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Some Mineral, Nutrient and Phenolic Components of *Zizyphus spina-christi* L. Fruits

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Abstract. The fruits of *Zizyphus spina-christi* L., as well as component parts, were analysed for their contents of some organic and inorganic constituents. It was found that embryos contained a high percentage of the ions Na, Mg, P and total-N. Other constituents such as Ca, K, Mn, Cu, carbohydrates, total phenols and ascorbic acid were quantified. The results indicate that this fruit has a good nutritive value.

Introduction

Zizyphus spina-christi L. shrubs grow wild in some parts of the Wadies (empty river beds) in the central part of Saudi Arabia. These shrubs are of great imporance for wildlife, and domestic animals especially camel, sheep, and goat. It was noticed that some animals feed on the leaves, twigs and the fruits while others feed on fruits only. Little information is available on the chemical composition of the fruits of this shrub while data are published for the allied *Zizyphus mauritiana* L. Khera and Sing [1] have compared sugar, protein and ascorbic acid content of the fruits of seven varieties of *Z. mauritiana*. Jain et al. [2] studied the effect of cold storage on the physicochemical characters of *Z. mauritiana* L. cv. umran fruit. These studies are concerned with cultivated species but basic research about the physiology as well as the chemistry of desert plants is much needed, so this study was undertaken to shed some light on the major mineral and nutrient constituents of these fruits as well as their constituent parts. The physiological implication of the constituents is also discussed.

Materials and Methods

Fruits of *Zizyphus spina-christi* L. were collected in 1986 from shrubs growing under natural conditions north of Riyadh ($\simeq$ 80 kilometers) and left to dry at room

temperature for three months. Some of the dried fruits were separated into three components; flesh, stone and embryo. Most of the analytical methods were the same as reported earlier for analysis of date palm seeds [3], so these methods will be mentioned in brief.

For inorganic analysis, samples were acid digested with concentrated H_2SO_4 on a hot plate then perchloric acid and H_2O_2 in the ratio of 1:1 by volume was added. Potassium was determined by flame emission while Na, Ca, Mg, Mn and Cu were determined by absorption flame spectrophotometer (Pye Unicam Sp 9 equipped with Sp 9 computer). Phosphorus was determined colourimetrically according to the method of Watanabe and Olsen [4].

Total-N was determined colormetrically by the method of Allen and Whitefield [5] and crude protein calculated as total-N X 6.25. Crude fat (as petroleum ether soluble fraction) was estimated according to the methods of A.O.A.C. [6]. Vitamin C was determined according to Bessy and King [7] and total phenols by the Folin-Ciocalteu reagent according to the method of Bray and Thorpe [8]. Total sugars were determined by the Somogyi method [9], while soluble sugars were determined and further identified by gas liquid chromatography (GLC) as reported earlier [10] after extraction by 80% ethanol and fractionation.

Results and Discussion

The concentrations found in the whole fruit or its parts (flesh, stone and embryo) are given in Tables 1,2 and 3 as ionic content, some organic constituents and carbohydrates respectively. Ionic contents quantified were Na, K, Ca, Mg, Mn, Cu and P. Each part contained different amounts of these elements but the stone, as expected, had the least of any of the fruit parts. Flesh and embryo differ in the quantity according to the element. Both N and P concentrations are high in the embryo, indicating the presence of high levels of protein and phospholipids. The latter is confirmed by the high ether extractable levels. On the other hand fat (as ether extractable) were higher in the embryo than in the flesh ($\approx$ 76 fold increase). High Na content in the embryo could be a natural adaptation to arid environment as the soil of deserts tend generally to be more saline than other soils. On the other hand, K and Ca were present in the flesh in large quantities ($\simeq$ 4 and 2 fold increase than that in the embryo). This might also indicate an adaptation to the soil of deserts as interpreted above for Na in the embryo. These findings indicate the compartmentation of these ions in the fruit parts. Other ions analysed (Mn and Cu) were almost the same in both parts.

Phenolic compounds were present in both flesh and stone parts of the fruit but only trace amounts were found in the embryo (Table 2). The presence of phenols in

Table 1. Some ionic contents of different fruit parts of *Zizyphus spina-christi* as μ mol g^{-1} dry wt. (Mean ± SE).

Ion	Flesh	Stone	Embryo	Whole fruit
Na	30.57 ±4.84	22.55 ±2.25	40.99 ±7.60	22.45 ± 2.07
K	402.20 ±1.37	47.53 ±1.26	100.99 ±4.26	183.69 ±5.83
Ca	106.26 ±0.48	39.41 ±2.43	54.31 ±4.35	68.37 ±2.47
Mg	30.37 ±1.13	6.27 ±0.26	62.51 ±1.41	16.99 ±0.31
Mn	11.13 ±1.60	8.98 ±0.95	11.77 ±1.82	8.07 ±0.62
Cu	3.79 ±0.26	3.30 ±0.14	3.82 ±0.30	1.36 ±0.29
P	22.16 ±1.05	5.96 ±0.14	196.15 ±5.46	25.32 ±0.92

Table 2. Some organic analysis of different fruit parts of *Zizyphus spina-christi* (for carbohydrates see Table 3).

	Flesh	Stone	Embryo	Whole fruit
Total-N (μ mol g^{-1} dry wt.)	15.33 ±1.87	8.89 ±1.65	93.62 ±4.94	21.83 ±3.35
Crude protein $\mu g g^{-1}$ (dry wt.) (Total-N X 6.25)	95.97 ± 11.68	55.58 ±10.32	585.09 ±30.83	136.44 ±20.91
Ether extract (% dry wt.)	0.46 ±0.01	0.09 ±0.07	35.20 ±0.69	2.98 ±0.10
Total phenols μ mol g^{-1} dry wt.	11.41 ±2.408	9.108 ±0.98	trace	13.94 ±1.96

the flesh might be the cause of the orange coloration of the fruits which might act as an attraction mechanism for wildlife to help in dispersing the seeds. Carbohydrates were present in all parts of the fruit where the highest concentration was in the flesh as indicated in Table 3 while the lowest concentrations were in the embryo. Two points could be drawn from the distribution of carbohydrates in the fruit. First, these

Table 3. Soluble and total carbohydrate content as well as ascorbic acid of different fruit parts of *Zizyphus spina-christi* (Mean ± SE).

Sugars	Flesh	Stone	Embryo	Whole fruit
Reducing (mgg^{-1} (dry wt.)	250.97 ±18.03	71,89 ±1.20	16.56 ±1.54	177.37 ±8.80
Non Reducing mgg^{-1} (dry wt.)	275.27 ±6.42	60.40 ±5.16	121.51 ±3.09	115.35 ±7.72
Total soluble carbohydrates mgg^{-1} (dry wt.)	526.29 ±24.48	132.29 ±4.15	138.07 ±4.36	292.61 ±8.07
Total carbohydrate mgg^{-1} (dry wt.)	558.11 ±22.37	311.23 ±55.8	193.42 ±1.58	384.67 ±16.19
Vitamin C mg $100g^{-1}$ (dry wt.)	66.78 ±0.79	29.32 ±4.17	158.02 ±17.48	50.56 ±6.05

finding could indicate that the main storage material of the seeds are not carbohydrates but lipids (cf. Table 2). Secondly, the presence of high concentration of carbohydrates in the flesh gives the sweet taste of the edible part (flesh) that attract wildlife to feed on the fruit. One interesting point in these results is the relatively high concentrations of non-reducing sugars in the embryo ($\simeq$ 7 fold increase of reducing sugars). This might reflect the need for an immediate source of energy at the time of seed germination before the activation of enzymes that break down the main storage material (i.e. lipids). Further analysis of soluble sugars of the whole fruit by GLC in the same way as that reported earlier for date palm seeds [3] showed that these sugars were fructose, glucose, and sucrose. Finally the chemical analysis of the dried fruits indicated that the embryo is very rich in ascorbic acid which is commonly known by vitamin C (Table 2). Of course, the comparison reported here is on the dried fruits that are reduced in Vitamin C levels and consequently only internal comparison are possible.

In general these results suggest that the fruits of *Zizyphus spina-christi* could be considered a good source of minerals and energy (carbohydrates and fat).

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المكونات غير العضوية والغذائية والفينولات في ثمار النبق البري

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المملكة العربية السعودية

(استُلم في ٤ رمضان ١٤٠٨هـ، قُبل للنشر في ٢٢ رجب ١٤٠٩هـ)

ملخص البحث. تم تحليل بعض المحتويات العضوية وغير العضوية لثمار النبق البري الكاملة وأجزائها (اللحمي والقصرة والجنين) حيث يستدل من النتائج أن الجنين يحوي نسبة عالية من عناصر الصوديوم والمغنيسيوم والفوسفور والنيتروجين الكلي حيث تصاحب ذلك كمية كبيرة من المحتوى البروتيني والدهون. بالإضافة إلى ذلك تم تقدير المكونات الأخرى مثل الكالسيوم والبوتاسيوم والمنجنيز والنحاس وكذلك السكريات والفينولات الكلية وفيتامين جـ. وتشير النتائج إلى أن هذه الثمار لها قيمة غذائية جيدة تساعد في تغذية الكائنات الحية التي تتغذى عليها.