

4.2.2 Processing of Haraz fruits jam

After determination of the suitable method and processing conditions for production of Haraz fruits extract, the cleaned Haraz fruits (4 kg) were soaked in boiled water (32 L) for (2hr). After that, the mix was blended for 5 min and the fruits extract after filtration was used for production of Haraz jam. Fig (1) and Table (2) show the processing method and recipe which were used for production of Haraz jam. While, Table (8) presents the physical and physico-chemical characteristics of Haraz fruit extract that used for jam production.

4.3 Quality evaluation of Haraz jam

4.3.1 Chemical and physico-chemical characteristics

The chemical and physico-chemical characteristics of Haraz jam are indicated in Table (9). From the results obtained in this study, the product was found to meet the recommended levels of total soluble solids (68%), hydrogen ions concentration (3.20) and titreable acidity (0.51 %) as reported by the **SSMO, 2006, Onsa (2007)** and **Javanmard (2010)**.

4.3.2 Nutritional value

4.3.2.1 Chemical composition and energy value

The chemical composition and energy value of Haraz jam are shown in Table (10). From the results, the product was found to be with high level of total sugars (64.30 %), but, with low level of protein (0.59 %), fiber (0.19 %), ash (00.18%) and tannin (00.12%), on wet basis. Therefore, the product was found to provide an adequate caloric value (271.55 k.cal/100g). The results obtained in this study are in good agreement with those published by **Elsayaid (2008)** and **Javanmard (2010)**.

Table (8): Physical and physico-chemical characteristics of Haraz fruits extract

Parameter	Haraz fruits extract
Weight of raw material	04.00 kg
Water weight	32.00 kg
Weight of Haraz extract	20.00 kg
Total soluble solids (T.S.S %)	05.00 %
Hydrogen ions concentration (pH)	04.87

Table (9): Chemical and Physico-chemical properties of Haraz jam

Chemical composition	On wet basis
	[n = 3 ± SD]
Total soluble solids (T.S.S %)	068.00 ± 0.00
Hydrogen Ion concentration (pH)	003.20 ± 1.06
Titreable acidity (%)	000.51 ± 1.06

Table (10): Chemical composition and energy value of Haraz jam

Chemical composition (%)	On wet basis
	[n = 3 ± SD]
Moisture	034.31 ± 0.61
Protein	000.59 ± 0.00
Fat	000.52 ± 0.10
Total sugars	064.30 ± 0.49
Reducing sugars	045.60 ± 0.48
Non reducing sugars	018.70 ± 1.06
Crude fiber	000.18 ± 0.00
Tannins	000.12 ± 0.00
Ash	000.10 ± 0.00
Caloric value	271.55 ± 0.00 k.cal 1136.17 ± 0.00 kj

SD ≡ Standard deviation.

n ≡ Number of independent determinations.

4.3.2.2 Minerals content

Table (11) gives the minerals concentration in Haraz jam as mg/100g on wet basis. The product was found to provide appreciable amounts of sodium (22.49 mg), potassium (8.98 mg), magnesium (8.38 mg) and calcium (8.14 mg). Therefore, the product was found with high nutritional value and it can be used especially for young children and mothers during pregnancy and lactating periods as suggested by **NRC (1983)**, **Von-Mydell (1986)** and **Abdoun (2005)**.

4.3.3 Organoleptic evaluation

The organoleptic evaluation of Haraz jams was carried out by using trained panelists from the Food Science and Technology Dept., College of Agricultural Studies, Sudan University of Science and Technology. Haraz jam products with or without flavour were sensory evaluated as described by **Ranganna (2001)**.

The results in Table (12) show the recorded scores by the panelists for the different Haraz jam samples with respect to their colour, taste, flavour, consistency and overall quality. In general, both Haraz jams that produced with or without flavour were highly accepted by the panelists. But, significant differences were found between the two products with respect to their colour, consistency and overall quality. However, Haraz jam that produced with pineapple flavour was highly preferred by the panelists in comparison with that produced without any flavour.

Table (11): Minerals content of Haraz jam

Minerals		On wet basis
		(mg/100g)
		(n =3± SD)
Sodium	[Na]	22.49 ± 0.00
Potassium	[K]	08.98 ± 0.00
Calcium	[Ca]	08.14 ± 0.00
Magnesium	[Mg]	08.38 ± 0.00
Iron	[Fe]	00.91 ± 0.00
Manganese	[Mn]	00.01 ± 0.00
Copper	[Cu]	00.11 ± 0.00

SD ≡ Standard deviation.

n ≡ Number of independent determinations.

Table (12): Organoleptic evaluation of Haraz jam products

Jam samples	Quality characteristics				
	Colour	Taste	Flavour	Consistency	Overall quality
	(Score , n = 20 ± SD)				
A	2.1 ± 0.59 ^a	2.1 ± 0.55 ^a	2.2 ± 0.54 ^a	3.3 ± 0.62 ^a	2.2 ± 0.56 ^a
B	1.5 ± 0.52 ^b	1.9 ± 0.52 ^a	1.9 ± 0.48 ^a	1.8 ± 0.54 ^b	1.7 ± 0.50 ^b
Lsd _{0.05}	0.5236*	0.3709 ^{ns}	0.4511 ^{ns}	1.0983 ^b	0.4306*
SE±	0.0718	0.0529	0.0607	0.0872	0.0600

Scale: 1 = excellent, 2 = very good, 3 = good, 4 = acceptable, 5 = unacceptable

A ≡ Haraz Jam without flavour.

B ≡ Haraz Jam with pineapple flavour .

SD ≡ Standard deviation.

Mean ± S.D value (s) bearing different superscript letter(s) within columns are significantly different (P≤0.05).

* ≡ Significant at (P≤0.05).

n.s ≡ Not significant.

Lsd_{0.05} ≡ Least significant difference at (P≤0.05).

SE± ≡ Overall experimental error.

5. CONCLUSION AND RECOMMENDATIONS

5.1 Conclusion

From the results obtained in this study it can be concluded that Haraz fruits are found to be suitable for production of jam with high nutritional value, high energy value and with appreciable amounts of sodium, potassium, magnesium, calcium and highly accepted by the panelists.

5.2 Recommendations

1. The product could be used for reducing the high incidences of energy-malnutrition among pre-school children in the rural areas, in Sudan.
2. Utilization of Haraz fruit in jam production will make the product very cheap and affordable especially for low income groups in Sudan.
3. The industrial utilization of Haraz fruits in jam production in Sudan should be encouraged.
4. Comprehensive survey for the different Haraz fruits production zones should be conducted to estimate the actual total production and productivity of the fruits in Sudan.
5. Additional studies are definitely needed to ensure safety, storage conditions, economic feasibility and market demands for the product.

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Plate (1): Haraz fruits



Plate (2): Haraz fruit jam



Plate (3): Sensory evaluation of Haraz fruits jam