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Comparison of Cold and Hot juice extraction from hibiscus(Karkadeh) and baobab(Tabaldi)

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Abstract: Juices of hibiscus and baobab are famous traditional sudanese beverages that can be extracted using cold and hot water. This research aimed to compare hot and cold juice extraction methods of hibiscus and baobab to select the best one which conserve the nutritive content (vitamins, fibre, and calcium oxlate), their original taste and also other aesthetics, represented by their physical (density, viscosity) and chemical (pH) properties. The hot extraction (70 ℃) was carried out in a water bath and the cold extraction (4 ℃) was done using ordinary tank for both the hibiscus and baobab, this is followed by determining physical and chemical properties of the extracted juices, and the obtained data were analyzed by the statistical package program (SAS-2004), an organoleptic test was also conducted at Berimer Food Factory. For the nutritive content, it was found that the cold extracted juices, for both materials contain higher percentage of vitamin c and fibre than the hot one. Whereas vitamin-c content in the cold extracted juices was higher than the hot extracted juices by 26 % and 55.4 % respectively, fibre content was more by 0.2 % and 0.1 % respectively. As regards calcium oxlate, it was lower by 1.6 % and 0.31 % .Protein content was lower by 0.3 % and 0.2 % respectively in cold extracted juices. For the physical and chemical properties, it was found that density and viscosity in the hot extracted juices were higher than those in the cold extracted juices by 0.1 % and 0.2 % respectively for hibiscus juice, and by 0.03 % and 0.25 % respectively for baobab juice. The Ph was lower (acidic) in the hot extracted juices than in the cold one for both by 0.2 % and 0.4 % respectively. The organoleptic test indicates that people prefer the cold extracted juices over the hot one.

Keywords: Organoleptic test. Baobab ,hibiscus

1. INTRODUCTION

Roselle (Hibiscus sabdariffa L.) belongs to the family Malvaceae, locally called “karkade”, is an important annual crop grown successfully in tropical and sub tropical climates [1]. The whole plant can be used as beverage, or the dried calyces can be soaked in water to prepare a colourful cold drink, or may be boiled in water and taken as a hot drink. It also has some medicinal properties [2]. Roselle is an important cash crop and a source of income for small farmers in western Sudan, especially in North Kordofan State. The crop is grown

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mainly by traditional farming methods, exclusively under rain-fed conditions [3]. The world's best roselle comes from the Sudan, but the quantity is low] [4]. Roselle may have been domesticated in western Sudan before 4000 BC; it was first recorded in Europe in AD 1576 [5]. Roselle is an annual crop used in food, animal feed, nutraceuticals, cosmeceuticals and pharmaceuticals. The calyces, stems and leaves are acid in flavor. The juice from the calyces is claimed to be a health-enhancing drink due to its high content of vitamin C, anthocyanins and other antioxidants [4]. Adansonia digitata L. (Bombacaceae family) locally called "tabaldi''. The English common name is baobab, probably derived from the Arabic buhibab, which means "fruit with several seeds". Baobabs store water in the trunk (up to 100,000 litres or 26,000 US gallons) to endure the harsh drought conditions particular to each region. The baobab tree is extremely important for humans and animals in the dry areas of Africa. It offers protection and provides food, clothing and medicine as well as raw material for many useful items. The tree has been known to be used for shelter. Baobab fruit pulp has a particularly high antioxidant capability mainly because of its high natural vitamin C content [6].

This research aimed to compare hot (70 ℃) and cold (4 ℃) juice extraction methods of hibiscus and baobab to select the best one which:

- Conserve the nutritive content (vitamins, fibre, protein, and calcium oxlate), their original taste and also other aesthetics, represented by their physical (density, viscosity) and chemical (pH) properties.

2. MATERIAL AND METHODS

2.1 The materials used in the research include:

1- Hibiscus flowers: Parts of the flower are used to make a popular drink in Sudan called **Karkade**. [7].

2- Baobab fruits: Baobab fruit drink is called **Tabaldi** in Sudan. It is a popular drink in Sudan [8].

3- Distilled water (solvent): Distilled water is water that has many of its impurities removed through distillation [9].

2.2 Steps of method

Step (1): Preparation of materials (clean, crush, weigh). Amount of 250 gram of hibiscus flowers and baobab fruits were used.

Step (2): Extraction; by using water bath for hot extraction at 70 C^o and ordinary tank for cold extraction at 4 C^o (refrigerator room temperature) with 1.750 L of distilled water.

Step (3): Use the Refractometer; during the experiment a sample is taken every 30 minutes to determine the concentration (Total soluble solid TSS) by Refractometer until a constant concentration is obtained. At that moment the maximum amount of hibiscus and baobab would totally be extracted.

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Step (4): Filtration; to separate extracted juices. After the juice is extracted it was directed to be separated using (Buchner funnel) in which the solid is totally removed.

Step (5): Analysis of extracted juices. See tables (1, 2, 3, and 4), figures (1, 2, 3, and 4)

Step (6): An organoleptic test: was also conducted at Berimer Food Factory

3. RESULTS AND DISCUSSIONS

The data obtained throughout the experiments were analyzed and interpreted. Summaries of results are generally presented in tables and figures.

Table 1. Analysis of cold extraction for hibiscus juice

Density (cm^3)	Viscosity (cp)	pH	Protein (%)	Fibre (%)	Vitamin C (%)	Oxalate (%)
1.1817	1.44633	2.28	0.6315	0.8217	31.6214	0.7318
1.1321	1.31833	2.31	0.3982	0.7621	31.8171	0.7818
1.2131	1.44	2.35	0.4181	0.8762	29.2981	0.6691

Table 2. Analysis of hot extraction for hibiscus juice

Density (cm^3)	Viscosity (cp)	pH	Protein (%)	Fibre (%)	Vitamin C (%)	Oxalate (%)
1.3172	1.83667	2.14	0.6397	0.6174	6.1817	2.3174
1.3219	1.772	2.1	0.7972	0.7271	5.2971	2.1981
1.3129	1.75233	2.12	0.8176	0.5291	3.7219	2.3917

Table 3. Analysis of cold extraction for baobab juice

Density (cm^3)	Viscosity (cp)	pH	Protein (%)	Fibre (%)	Vitamin C (%)	Oxalate (%)
1.3617	3.10367	3.11	0.3176	0.3179	67.8171	0.0377
1.2981	2.75033	3.21	0.1921	0.1821	68.2971	0.0297
1.3176	2.619	3.13	0.2171	0.4176	67.2917	0.0378

Table 4. Analysis of hot extraction for baobab juice

Density (cm^3)	Viscosity (cp)	pH	Protein (%)	Fibre (%)	Vitamin C (%)	Oxalate (%)
1.3718	3.83733	2.79	0.4762	0.2176	15.7621	0.4171
1.3671	3.83933	2.73	0.3917	0.2321	11.3191	0.3211
1.3812	3.65033	2.87	0.3192	0.2197	10.219	0.297

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.1 Statistical analysis

Results expressed as the mean value ± standard deviation (SD) were performed using Least Significant Difference according to the procedures described by Gomez and Gomez (1984). Data were assigned in a Completely Randomized Design (CRD). Software of the Statistical Analysis Systems (SAS, 2004) was used to analyze data [10]. See table (5, 6)

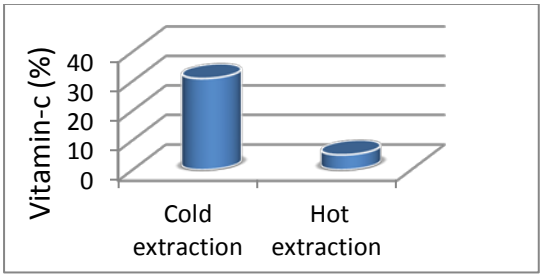

Figure 1. Effect of extraction methods on the vitamin-c for hibiscus juice

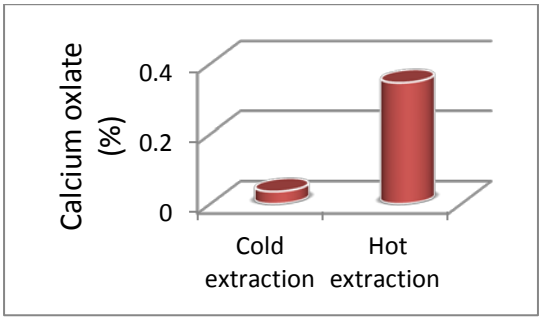

Figure 2. Effect of extraction methods on the calcium oxlate for baobab juice

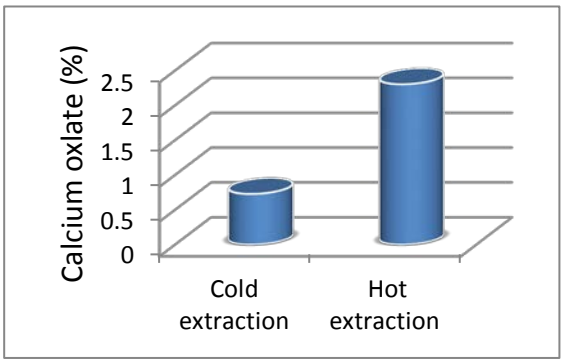

Figure 3. Effect of extraction methods on the calcium oxlate for hibiscus juice

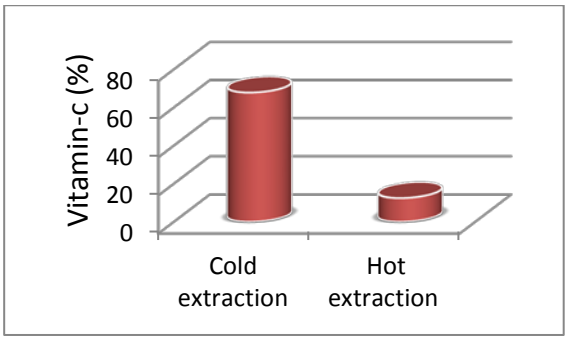

Figure 4. Effect of extraction methods on the Vitamin-C for baobab juice

Table 5. Effect of extraction methods on the vitamin-C mg/100g for extracted juices

Method of Extraction	Vitamin-C	
	Hibiscus	Baobab
Cold extraction	30.91[a] ±1.40	67.80[a]±0.50
Hot extraction	5.07[b] ±1.24	12.42[b] ±2.93
Lsd# p ≤ 0.05	1.461	7.130

Table 6. Effect of extraction methods on the calcium oxalate (%) for extracted juices

Method of Extraction	Calcium oxalate	
	Hibiscus	Baobab
Cold extraction	0.728^{b} ±0.05	0.035^{b} ±0.006
Hot extraction	2.30^{a} ±0.097	0.345^{a} ±0.063
Lsd# $p \leq 0.05$	0.381	0.155

Mean±SD value(s) bearing different superscript letter(s) within the same column differ significantly (P≤0.05).

Based on the obtained results significant differences were obtained in term of:

- The nutritive content, taste and the physical and chemical properties, when the juices are extracted using cold and hot water.

- It was obtained a good nutritive content juice full of vitamins and fibre, when the cold extraction of hibiscus and baobab was performed, whereas this content decreased in the hot extracted juices.

- It was found that the cold extraction decreased the extraction of calcium oxlate in large quantities which is not beneficial for health, which in turn justifies the non-existence of metallic taste that exist in the hot extraction, for this reason the **organoleptic test (sensory evaluation)** indicates that people prefer the cold extracted juices over the hot one.

- It observed that the results are similar for hibiscus and baobab (increasing or decreasing), but with different values.

- According to the obtained results it was found that the usage of cold extraction is better than the hot one.

Table 7. Comparison between cold extraction (4℃) of hibiscus juice and hot extraction (70℃) in term of nutritive content

Nutritive content	Percentage % (in cold than in hot)
Vitamin c	> 26
Protein	< 0.3
Fibre	> 0.2
Calcium oxlate	< 1.6

Table 8. Comparison between cold extraction (4℃) of baobab juice and hot extraction (70℃) in term of nutritive content

Nutritive content	Percentage % (in cold than in hot)
Vitamin c	> 55.4
Protein	< 0.2
Fibre	> 0.1
Calcium oxlate	< 0.31

Table 9. Comparison between cold extraction (4℃) of hibiscus juice and hot extraction (70℃) in term of physical and chemical properties

Physical and Chemical properties	Percentage % (in cold than in hot)
Viscosity	< 0.2
Density	< 0.1
pH	> 0.2

Table 10. Comparison between cold extraction (4℃)of baobab juice and hot extraction (70℃) in term of physical and chemical properties

Physical and Chemical properties	Percentage % (in cold than in hot)
Viscosity	< 0.25
Density	< 0.03
pH	> 0.4

4. Conclusion

Two methods of extraction (hot, cold) were used to extract hibiscus and baobab by using distilled water as solvent. According to the obtained results it is found that cold extraction (4 ℃) is better for both species in different aspects except for the protein content which was higher when using hot extraction (70 ℃), whereas the cold extraction keeps juices with high quality in term of the nutrient content (vitamins, fibre) and improves its physical and chemical properties.

The following recommendations should be undertaken into considerations:

- The extract hibiscus and baobab using cold water (4 ℃), instead of hot water (70 ℃) this is to obtain juice with:

  - Highly nutritive content of vitamins and fibre.
  - Better physical and chemical properties.
  - Better taste: less amount of calcium oxlate.

- Conduct further research on the issue by using hot and cold extraction methods upon big quantities of hibiscus and baobab plants and performing more analysis on the extracted juices to define the optimum temperature for extraction.

- The concerning authority must avail the suitable condition for the growing of these plants all over the year and support the farmer to find irrigation source so as to benefit from it economically.

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