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Development of indirect UV spectrophotometric method for the determination of vitamin C content in *Prosopis juliflora and Balanites eagyptica* using standard ceric (IV) sulphate

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Abstract:

In the present work three ultraviolet spectrophotometric methods of analysis were developed depending principally on the measurement of absorbance of ceric (IV) ions in 5M H_2SO_4 at 323nm.The first , for the direct determination of ceric(IV) ions, where as the second, for the indirect determination of vitamin C but also through the measurement of the absorbance of the unreduced standard ceric(IV) ions after the addition of standard vitamin C .The third , applied the second method to determine vitamin C content in the extract of fruits (385ppm) and leaves (485ppm) of Balanites eagyptica (laloub) and of fruits (216ppm) and leaves (315ppm) of Prosopis juliflora (mesquite).

Key words: *Balanites eagyptica*, *Prosopis juliflora*, laloub, mesquite, ascorbic acid, ceric (IV) sulphate, spectrophotometric method.

1. INTRODUCTION

Various analytical methods have been employed for the determination of ascorbic acid in different matrices including titrimetry, voltammetry [1]-[6], liquid chromatography [1]-[9], complexometry [3], spectrophotometry, amperometry and enzymatic methods [3]-[10]-[11].

Titrimetric methods have been commonly used in the determination of vitamin C in fruit samples because they are simple; however, difficulties were encountered with commonly used titrants and interferences also occurred with colored samples [1].

Prosopis juliflora (mesquite) was introduced into Sudan since 1917 and planted in Khartoum .Its ability to tolerate drought and fix sand dunes provided the impetus for the introduction of the tree into various parts of Sudan (central, northern and eastern Sudan) with emphasis on dry areas [12]. *Balanites aegyptiaca* (laloub) is also widely distributed in Sudan such as Kordofan and Darfur [13].

Fruits and leaves of *Balanites eagyptica* and *Prosopis juliflora*, are expected to contain micro - and macro - nutrients, minerals and vitamins including vitamin C.

No investigations in the methods of extraction and determination of vitamin C in fruits and leaves of *Balanites eagyptica* and *Prosopis juliflora* in Sudan have been reported.

In the present work various methods of extraction of vitamin C, from fruits and leaves of *Balanites eagyptica* and *Prosopis juliflora, and* the determination of its content by indirect uv- spectrophotometry using ceric (VI) sulphate will be investigated.

2. Materials and methods

2.1 Chemicals

All chemicals used were of analytical grade.

- L (+) Ascorbic acid powder (ANKARA .TORKIYE).
- Ceric sulphate,$Ce(SO_4)_2$ $2H_2O$, 99.9% pure, BDH Poole England.

- Sulphuric acid (INDIA).
- Metaphosphoric acid (Sigma-Aldrich (Johannesburg, South Africa).
- Acetic acid (Fluka) (chemika).

2.2 Equipment

- UV/VIS spectro star Nano (BMG LABTECH) with 1-cm matched quartz cells.

2-3 Samples

Both leaves of *Balanites eagyptica*(BL) and *Prosopis juliflora* (PL) and fruits of the latter (PF) were collected from the trees grown in the different parts of Khartoum State (Sudan). However, fruits of the former (BF) were purchased from Khartoum State market.

2.4 Preparation of solutions

Ceric (IV) sulphate solution (1000ppm)

0.1g of ceric (IV) sulphate ($Ce(SO_4)_2 \cdot 2H_2O$) was weighed accurately, dissolved in 5M H_2SO_4 and diluted to 100 ml with distilled water.

Ascorbic acid (100 ppm)

0.01g ascorbic acid (A.R.) was weighed accurately, dissolved and diluted to 100ml with distilled water.

Blank

0.5ml 5M H_2SO_4 was diluted to 50 ml with distilled water.

2.5 Extraction methods of vitamin C

1 g of each of the fruits and leaves was weighed and crushed, to which, 25 ml of each solvents (distilled water, 4.5%metaphosphoric acid or acetic acid) was added and after 30 minutes the contents were squeezed and filtered.

2.6 Optimization of the experimental conditions

The effect of various parameters comprising wavelength of maximum absorption, temperature and temperature was investigated .Absorbance of ceric (IV) sulphate was measured at five wavelengths (300,323,325,332 and 340nm) and the maximum absorbance was obtained at 323nm.The absorbance of ceric(IV) sulphate was also measured in 4M,5M and 6M H_2SO_4 . The maximum absorbance was obtained in5M H_2SO_4.

3. RESULTS AND DISCUSSION

3.1 UV spectrophotometric method for the determination of ceric(IV) sulphate

Different concentrations of ceric (IV) sulphate in 5M H_2SO_4were prepared and their absorbance at 323nm was recorded in Table 1 and drawn in Figure 1.

Table 1 Absorbance of ceric (IV) sulphate standard in 5M H_2SO_4 at 323nm

Ceric (IV)sulphate concentration ppm	20	40	60	80	100	120	140	150
Absorbance	0.182	0.380	0.592	0.782	0.999	1.231	1.451	1.647

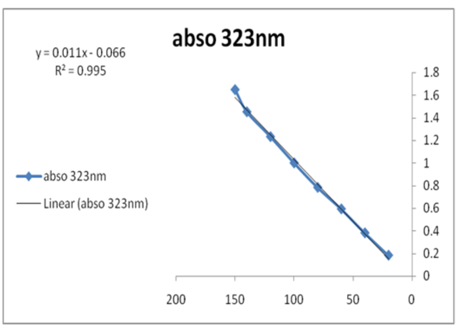

Figure 1 Beer's law plot of ceric (IV) sulphate standard in 5M H_2SO_4 at 323nm

3.2 Indirect UV spectrophotometric determination of ascorbic acid in *Balanites eagyptica* and *Prosopis juliflora* using ceric (IV) sulphate

1 ml of each vitamin C filtrate (using distilled water, 4.5% metaphosphoric acid or acetic acid) was pipetted into 50 ml volumetric flask, and 5 ml ceric (IV) sulphate (150 ppm) was added. This was then completed to the mark with distilled water. Absorbance of 150 ppm ceric (IV) sulphate, in 5M H_2SO_4 which was not reduced after the addition of varing volumes of 100 ppm ascorbic acid was recorded in Table 2 and Figure 2.

Table 2 Absorbance of ceric(IV) sulphate after addition of ascorbic acid

Ascorbic acid volumes (ml)	Absorbance at 323nm
0	0.781
0.2	0.725
0.4	0.653
0.6	0.590
0.8	0.536
1	0.464
1.2	0.396
1.4	0.334
1.6	0.275
1.8	0.236
2	0.157
2.2	0.103
2.4	0.051
2.6	0.028

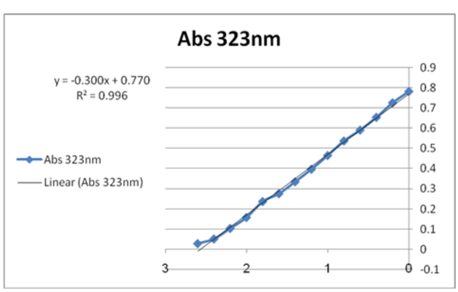

Figure 2 Beer's law plot of ascorbic acid solutions at 323nm

3.3 Efficiency of the extracting solutions

Distilled water, metaphosphoric acid and acetic acid were used to extract vitamin C from fruits or leaves of *Balanites eagyptica* and *Prosopis juliflora.*

Vitamin C concentration was determined in these extracts and the results obtained are shown in Table .3.

Table 3 Ascorbic acid contents in fruits and leaves of *Balanites eagyptica* and *Prosopis juliflora*.

Common name	Botanical name	Ascorbic acid conc extracted with distilled.water ppm	Ascorbic acid conc extracted with M.phosphoric acid ppm	Ascorbic acid conc extractedwith acetic acid ppm
Laloub	*Balanites eagyptica* F	326	380	361
Laloub	*Balanites eagyptica* L	423	465	441
Mesquite	*Prosopis juliflora* F	179	216	198
Mesquite	*Prosopis juliflora* L	283	315	306

Metaphosphoric acid was the most efficient extracting solution for both leaves (465ppm, 315ppm) and fruits (380ppm, 216ppm) of *Balanites eagyptica* and *Prosopis juliflora*, respectively. Distilled water was the least, for leaves (423ppm, 283ppm) and fruits (326ppm,179ppm), respectively. In between, acetic acid showed middle efficiency (441ppm, 306ppm) for leaves and (361ppm, 198ppm) for fruits, of *Balanites eagyptica* and *Prosopis juliflora,* respectively. The success attained in development of an indirect UV spectrophotometric determination of vitamin C content in laloub and mesquite tempts to investigate the application of the method for the determination of other constituents in other dry food materials using even indirect other instrumental techniques.

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