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Effect of Cooking Methods on the β-carotene Content of Jute Mallow Leaves (*Corchorus olitorius*)

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Abstract The objective of this study was to evaluate the effect of different cooking methods on the β-carotene content of jute mallow (*Corchorus olitorius*) leaves. Three cooking methods have been experimented. Jute mallow raw leaves was respectively boiled for 15 and 30 minutes in water (CW), in water containing ash leachate (CWA) and frying for 5 minutes followed by cooking with water (CWF) for 15 and 30 minutes. The β-carotene content of raw *Corchorus olitorius* (jute mallow) leaves were 9774.90 µg/100g dry matter basis. The β-carotene content decrease significantly (p=0.00) during the different types processing. However, the β-carotene content on leaves cooked using ash leachate (3604.00 µg/100g and 3768.80 µg/100g) was significantly (p=0.00) higher that on leaves cooked in water (2285.50 µg/100g and 2365.00 µg/100g) respectively for 15 minutes and 30 minutes. The highest loss (86.42%) of β-carotene was observed for leaves fried for 5 minutes followed by 30 minutes cooking. These results demonstrated that any of the cooking methods used lead significantly (p=0.00) to a decrease of the β-carotene content of jute mallow leaves, but addition of ash leachate during cooking improves significantly (p=0.00) the β-carotene retention.

Keywords: *jute mallow leaves, beta carotene, cooking, frying, ash leachate*

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1. Introduction

Jute mallow leaves are an important leafy vegetable in Africa. The consumption of jute mallow is well-spread in several countries in Africa and Asia [1]. In Burkina Faso jute mallow was identified among the most vegetable consumed by local inhabitant [2]. Leaves of jute mallow are indeed used for several diet preparation, and were most consumed as sauces, balls and soups [3]. Previous studies reported that jute mallow leaves are good source of beta carotene [4,5]. Beta carotene is the major provitamin A in vegetables. It is bio converted into retinol before to be absorbed by human body. Vitamin A play an important role for human body and it's deficiency represent a public health problem which required mobilization of important resources especially in poor countries. Investigations on the nutritional content of some traditional vegetables demonstrated that among the three most vegetables consumed, jute mallow leaves had the highest content of β-carotene [5]. Cooking by boiling was reported to be the most commonly method used on vegetables preparation, however it lead to the loss of nutrients [4,5,6]. Previous studies reported that the loss of nutrients during cooking varies with the duration of the processing [4,5]. For jute mallow leaves, cooking time depend on the recipes and the moment of introduction of leaves on the sauces during preparation [7].

The objective of this study is to evaluate the effect of different cooking methods on the β-carotene content of jute mallow (*Corchorus olitorius*) leaves. Three cooking methods have been applied to vegetables including cooking with water, cooking with water added ash leachate and frying.

2. Material and Methods

2.1. Raw Material

The raw material was jute mallow leaves (Figure 1.a.), water, vegetable oil and solid ash leachate (Figure 1.b.). Jute mallow leaves were collected in a peri-urban garden in Loumbila, a department located at 20 km from Ouagadougou.

Solid ash leachate and vegetable oil were bought on the market. Solid ash leachate consists of pellets obtained from ashes of stems of crops generally.

Leaves were washed three times respectively with tap water and then wrung out. They were trimmed and then divided into three parts. The first and the second parts were subjected to cooking with water (BW), and cooking

with water contained ash leachate (BWA) during 15 minutes and 30 minutes respectively. The third part was fried for 5 minutes on vegetable oil and then boiled respectively (BWF) during 15 and 30 minutes (Table 1). After 5 minutes of frying, 500 ml of water was added. The whole was boiled for 15 minutes and 30 minutes. The cooking time were chosen in respect of the results of a previous study, which reveal an important losses of beta carotene in jute mallow leaves boiled during 30 minutes and 60 minutes respectively [5].

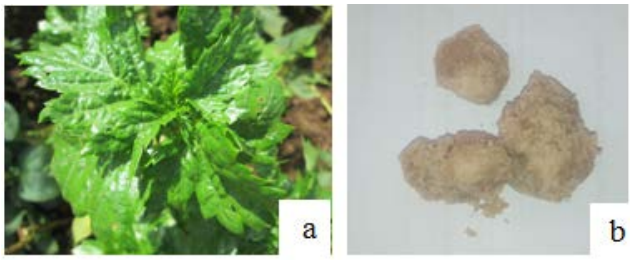

Figure 1. Jute mallow (*Corchorus olitorius*) leaves (a) and ash leachate (b)

Table 1. Experimental design

Process	Raw material used			
	Raw leaves (g)	Water (g)	Ash leachate (g)	Oil (g)
Cooking in water	100	500	0	0
Cooking in water containing ash leachate	100	500	2	0
Cooking in water after 5 minutes of frying	100	500	0	75

2.2. Determination of Beta Carotene Content

Beta carotene content of jute mallow leaves was determined by HPLC as described by Craft (1992), using of C18 nucleosyl, SUPELCO LC18 model, 25 mm long, 4,6mm in diameter with particles of size 5µm.

One gram of sample was taken in a dry 10 ml test tube and then, 2 ml of hexane, 1 ml of ethanol and 1 ml of distilled water were added. The mixture was vortexed for 2 min and let macerate at 4°C in a refrigerator for 24 hours. The macerate was then centrifuged at 3000 rpm for 10 min. The supernatant was then collected on a dry 10 ml test tube. 2 ml of hexane was added to the pellet, vortexed for 2 min and centrifuged at 3000 rpm for 10 min. The supernatant was collected and added to the first supernatant. 1 ml of Di-Methyl-Formamid was added to the supernatant in order to precipitate chlorophyll. The hexane phase was transferred in a 5 ml test tube and then evaporated under nitrogen. The contents of the tube were taken up in 1 ml of mobile phase (acetonitrile 70%, dichloromethane 20%, methanol 10%) and then vortexed. 20 ml of this mixture were injected in duplicate. The peaks obtained have been integrated and the areas raised.

A solution of beta carotene in HPLC grade hexane (60 picomoles /20 picomoles) was used as standard.

Beta carotene content was determined from concentration of the standard and its peak area value and sample peak area. beta carotene content was then converted to micrograms/100 grams (µg/100g). The analyzes were performed in triplicate.

2.3. Statistical Analysis

The data was entered with the Microsoft Office Excel 2010 version 2015 software. The data were subjected to one-way analysis of variance (ANOVA). Means were separated by the Tukey test based on the HSD test using the Minitab 18 at $p \leq 0.05$.

3. Results

3.1. Cooking of Jute Mallow Leaves in Water

The Figure 1 present the variation of beta carotene content of jute mallow leaves during processes. Results show that there was loss of beta carotene. The losses were different, depending on cooking method used. Beta carotene content of raw leaves was 12313.10±299 µg/100g. Results show that beta carotene content decreased with the cooking methods applied to leaves for all the processes.

The beta carotene content of leaves cooked with water was 2878.99±67.41 µg/100g and 2979.07±109.39 µg/100g respectively for 15 (BW15) minutes and 30 (BW30) minutes cooking. However, there was not significant difference between those samples ($p \leq 0.05$).

3.2. Cooking of Jute Mallow Leaves in Alkalinized Water: Usage of Ash Leachate

For leaves cooked in alkalinized water, beta carotene content was 4539.90±231.19 µg/100g and 4747.47±295.96 µg/100g for cooking during 15 minutes (BWA15) and cooking during 30 minutes (BWA30) respectivly. Using of ash leachate increased significantly the pH from 5.98 to 8.91 (BWA15) and to 8.81 (BWA30) of leaves (Figure 2). The beta carotene of leaves cooked with alkalinized water was significantly higher than those cooked in no alkalinized water at $p \leq 0.05$.

The Figure 3 showed that adding ash leachate increased pH of BWA15 and BWA30. The pH value of those samples was different to all of the cooked leaves ($p \leq 0.05$). This increase of pH lead to better retention of beta carotene.

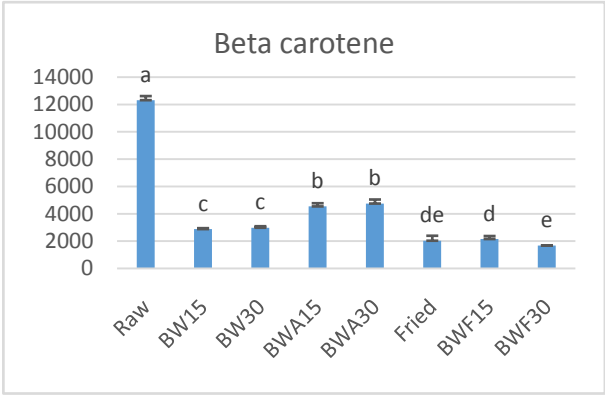

Figure 2. Beta carotene content in raw and processed leaves

Values followed by the same letter are not significantly different at $P \leq 0.05$.

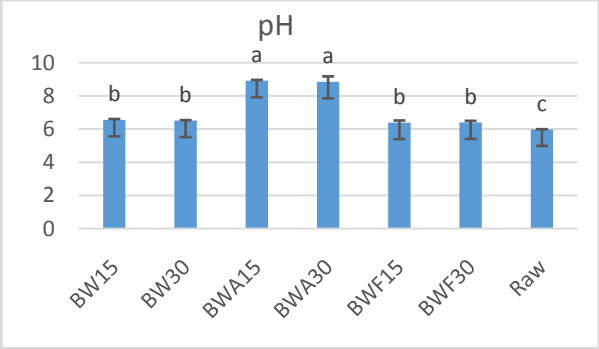

Figure 3. pH of raw and processed leaves

Values followed by the same letter are not significantly different at P≤0.05.

3.3. Frying of Jute Mallow Leaves Followed by Cooking with Water

Results show that frying for 5 minutes before cooking in water decreased significantly (p≤ 0.05) the beta carotene content. The losses ranged from 2029.65±362.58 µg/100g to 12313.10±299 µg/100g. A beta carotene content of leaves fried before cooking in water was 2152.19±219.40 µg/100g for 15 minutes cooking (BWF15) and 1671.58±2.90 µg/100g for 30 minutes cooking (BWF15).

4. Discussion

4.1. Effect of Cooking on Beta Carotene Content

For all the cooking methods used, there were a loss of beta carotene after 15 and 30 minutes. However, there were no significant (p≤0.05) difference between beta carotene content of leaves cooked for 15 minutes and 30 minutes. Losses of beta carotene during cooking ranged from 61.44% (BWA30) to 86.42% (BWF30). These results are in agreement with previous investigations of Anjum (2008) [8] who reported a significant reduction in the beta-carotene content of some Indian vegetables from 8.8 to 62.7% when cooked at different time ranged from 0 to 20 minutes. Reduction observed during cooking could be explained by isomerization occurred during cooking that transforms trans configuration of carotenoid in cis configuration which makes them less bioactive [9].

Ash leachate is traditionally used by household as an ingredient in the preparation of some vegetables sauces [10]. The use of ash leachate in the preparation of vegetables aims to neutralize acidity of the leaves, reduce cooking time or preserve color of the leaves. Using of ash leachate increase the pH of leaves and enhance beta carotene retention of jute mallow leaves, in comparison to those cooked without ash leachate. This retention could be due to the reaction of beta carotene at alkaline pH.

4.2. Effect of Cooking Fluid on Beta Carotene Content

There was an important loss of beta carotene when frying jute mallow leaves for 5 minutes (83.52%). These losses could be due to the temperature of the frying oil. During frying, the temperature reached up to 110.36 ± 3.50°C. This temperature was outside the interval 60 to 100°C which is stability range of beta carotene [11]. These results differ from those found by Tessier [12], who reported less than 20% loss for provitamin A during cooking.

Amount all of the processes applied to leaves, cooking in alkalinized water (using ash leachate) presented the high beta carotene content (4537.90 et 4747.47 µg/100g respectively for BWA15 and BWA30). Beta carotene is converted to retinol with proportion 1/6 before to be absorbed by organism. That means that 6 µg of beta carotene is necessary to get 1 µg of retinol. Based on this proportion, beta carotene containing on leaves cooked using ash leachate corresponded respectively to 756.31 µg ER/100g (BWA15) and 791.24 µg ER/100g (BWA30).

According to WHO/FAO (2004), the means needs of beta carotene for children aged from 7 to 9 years is 250 µg ER. Consumption of 31.59g of this preparation is theorical sufficient to satisfy the mean need of vitamin A for children from 4 to 6 year.

5. Conclusion

Cooking methods affected significantly beta carotene content of jute mallow leaves, by reducing the content in the processed leaves. Losses was important when using the frying process. Use of ash leachate improved the beta-carotene during cooking. There was no significant difference between cooking for 15 and 30 minutes for the same cooking method.

In order to take advantage of the beta carotene from jute mallow leaves, use of ash leachate would be recommended, and it would be interesting to choose recipes which leaves would be cooked for shorter time.

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