Effect of some treatments on colour parameters and antioxidant potentials of *Corcorus olitorius* broth

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Abstract

Scientific research reports have revealed the high nutritional values, especially micronutrients, of leafy vegetables. African leafy vegetables are mostly harvested fresh and made into broths for immediate consumption. The effect of some preprocessing treatments on the *Corcorus olitorius* vegetable, an important African leafy vegetable, were assessed on colour parameters and antioxidant potentials of its broth. Freshly harvested leaves of *C. olitorius* were subjected to osmotic dehydration and steam blanching prior to drying, and direct drying. Two drying conditions of oven drying at 35°C for 24 h and tray-drying under prevailing laboratory environment conditions were separately employed before cooking into broths. Broth from fresh *C. olitorius* leaves served as control. Generally, pre-processing treatments increased the lightness (L*) index of the broth significantly ($p<0.05$) from 44.03 to 58.53. Greenness, shown by the negative a* values, and the yellowness, positive b values, significantly ($p<0.05$) decreased from -12.21 to -5.37 and 22.73 to 10.23, respectively. Antioxidant potentials, evaluated using 2,2-diphenyl-1-picrylhydrazyl (DPPH), also showed a general decrease with applications of pretreatments (67.90 to 37.77%). The results from this research is expected to guide on the selection of the pre-processing treatment(s) to obtain optimal nutritive quality from *C. olitorius* broth.

Keywords: quality, vegetable, osmotic dehydration, blanching, drying, antioxidant properties

INTRODUCTION

Vegetables are fresh and edible portions of herbaceous plants eaten raw or cooked (Adeniyi et al., 2012). They play important roles in human nutrition as they serve as important sources of digestible and indigestible carbohydrate, minerals and vitamins (Shitanda and Wanjala, 2006). Vegetables are highly perishable, they respire and transpire after harvest, leading to loss of quality (Shitanda and Wanjala, 2006). These physiological changes decline the quality of these vegetables and reduces their shelf life (Shitanda and Wanjala, 2006).

Reducing the moisture content of vegetables can reduce the undesirable physiological changes that occur in these vegetables due to a reduction in the water activity (Ibarz and Barbosa-Canovas, 2002). Also, the availability of vegetables all year round can be made possible through this preservation process. However, the drying conditions influence the physicochemical properties of the vegetables. For instance during drying, non-enzymatic browning may occur, nutrients may be lost and the dried products may sometimes have poor rehydration characteristics (Hebbar et al., 2004). Various studies have been done to reduce this postharvest loss. Korus (2013) reported a decrease in the chlorophylls and carotenoids content of air dried Kale (*Brassica oleracea* L. var. *acephala)* leaves (water blanched at 96-98°C for 2.5 min prior to air drying at 55°C). Also the colour, odour, appearance and relative reconstitution capacity of coriander (*Coriandrum sativum*), mint (*Mentha spicata*), amaranth (*Amaranthus* sp.), fenugreek (*Trigonella foenum graecum*) and shepu (*Peucedanum graveolens*) were influenced by microwave drying (Fathima et al., 2001).

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Usually the drying of leafy vegetables is preceded by different chemical and non-chemical pre-drying treatments like blanching, osmotic dewatering, immersing in acidic and salt solutions (Lewicki, 1998). *Corchorus olitorius* is a leafy vegetable indigenous to tropical Africa and Asia (Adeniyi et al., 2012). The leaf is widely used in preparing soups and for folk medicine among rural communities (Adeniyi et al., 2012; Oboh et al., 2009). *C. olitorius* is also a very important source of fibre for both textile and non-textile uses (Nayak and Roy, 2011).

Different researchers have subjected *C. olitorius* leaves to various drying conditions. For instance, Shitanda and Wanjala (2006) reported a significant change in the colour and texture of sun and vacuum dried *C. olitorius* leaves. There was a colour change from green to brown due to the degradation of the chlorophyll and oxidation. Also, about a 65% loss of ascorbic acid was recorded for leaves dried under shade and about 90% for sun-dried leaves (Shitanda and Wanjala, 2006). In this study, the effect pre-treatments (osmotic dehydration, and steam blanching) and different drying conditions viz; controlled atmosphere drying (30°C, 56% relative humidity), oven drying (temperature) and room temperature drying on colour parameters and antioxidant properties of *C. olitorius* broth were investigated.

MATERIALS AND METHODS

Fresh *C. olitorius* leaves were obtained from the University of KwaZulu-Natal research farm in Pietermaritzburg, South Africa. The fresh leaves were divided into eight batches. A batch was dried at room temperature and then cooked; another was dried under a controlled atmosphere of 30°C and 56% relative humidity using Climate Test Chamber (CTS) (Model C-40/100) and then cooked; another portion was subjected to osmotic dehydration, drained and then dried at room temperature before cooking; another portion was subjected to osmotic dehydration, drained and then dried under a controlled atmosphere before cooking; two batches were steam blanched, one was then dried at room temperature before cooking while the other was dried under controlled atmosphere before cooking. A batch was cooked directly without any pretreatment while the last batch was freeze dried without any processing. All processed samples were also freeze dried and refrigerated until further analysis.

Hunter-lab colour measurement

Colour measurement of the flour samples were determined using a hunter-lab colour flex on the basis of lightness (L*), red-green (a*) and yellow-blue (b*) values. The instrument was calibrated against white and black coloured tiles before taking colour measurements.

1,1-Diphenyl-2-picryl-hydrazyl (DPPH) radical scavenging assay

DPPH radical scavenging assay was done as described by Moodley et al. (2015) with slight modifications. Briefly, a solution of 0.135 mM DPPH in methanol was prepared and 1.0 mL of this solution was mixed with 1.0 mL of the extracted sample. The reaction mixture was vortexed thoroughly and left in the dark at room temperature for 30 min. The absorbance of the mixture was measured spectrophotometrically using a Shimadzu UV 1800 at 517 nm. The ability to scavenge DPPH radical was calculated by the following equation:

$$\text{Radical scavenging activity (\%)} = [(Abs_{control} - Abs_{sample})/(Abs_{control})] \times 100 \quad (1)$$

where $Abs_{control}$ is the absorbance of DPPH radical+methanol; Abs_{sample} is the absorbance of DPPH radical+sample extract/standard.

Data analysis

The data was analysed using SPSS version 15. Means of replicated samples were separated by Duncan Multiple Range Test.

RESULTS AND DISCUSSION

Changes in broth colour

Colour parameters of broths from fresh and treated *C. olitorius* are shown in Table 1. Generally, pre-processing treatment caused significant ($p<0.05$) increase in the lightness index, L*, of the broth. Pre-processing treatments imparted negatively on the green colour of the *C. olitorius* broth as evidenced by the increase in a* values from -12.21 to -5.37. Negative value of a* indicates greenness. Increasing negative values imply higher greenness. A decrease in the greenness index with the treatments reflects an adverse effect of the treatment on the chlorophyll retention. Maharaj and Sankat (1996) also observed a marked decrease in the green colour of dasheen leaves subjected to blanching and drying. The decrease in green colour was highly correlated with loss of chlorophylll.

Table 1. Effect of processing on Hunter colour lab values.

Samples	Treatment	L*	a*	b*
FCE	Cooked	$44.03^{d}\pm0.18$	$-12.21^{f}\pm0.03$	$22.73^{a}\pm0.12$
FRC	Dried at room temp then cooked	$45.79^{cd}\pm0.49$	$-8.84^{d}\pm0.04$	$18.48^{bc}\pm0.08$
FCA	Controlled atmosphere drying and then cooked	$44.70^{d}\pm0.11$	$-7.80^{c}\pm0.32$	$19.01^{b}\pm0.64$
FOR	Osmotic dehydration, room dried and cooked	$51.87^{b}\pm0.30$	$-6.45^{b}\pm0.01$	$12.79^{f}\pm0.21$
FOC	Osmotic dehydration, dried under controlled atmosphere and cooked	$58.53^{a}\pm1.57$	$-5.37^{a}\pm0.04$	$10.23^{g}\pm0.03$
FSR	Steam blanched, room dried and cooked	$44.55^{d}\pm0.00$	$-6.65^{b}\pm0.00$	$17.44^{de}\pm0.00$
FSC	Steam blanched, dried under controlled atmosphere then cooked	$48.08^{c}\pm3.27$	$-7.49^{c}\pm0.44$	$17.22^{e}\pm0.35$
FEL	Fresh leaves	$36.93^{e}\pm0.42$	$-10.34^{e}\pm0.30$	$18.00^{cd}\pm0.09$

Mean ± SD. Means with different superscripts in a column are significantly different ($p<0.05$).

Changes in free scavenging ability of broth

The effect of pre-processing treatments on free radical scavenging ability of the resulting broths is shown in Table 2. Free radical scavenging ability is a measure of the antioxidant potentials of the broths. Pre-processing treatments generally led to reduced antioxidant potentials of the resulting broths. Oboh (2005) similarly reported that blanching caused a marked reduction in antioxidant properties of some leafy vegetables. Cooking without other treatments led to the highest DPPH % compared to DPPH in the sample fresh leave. Drying of fresh leaves at room temperature before thermal processing of the broth significantly reduced the free radical scavenging ability of the final product.

Table 2. Effects of different treatment combinations on changes in 1,1-diphenyl-2-picryl-hydrazyl (DPPH).

Samples	Treatment	DPPH (%)
FCE	Cooked	67.9
FRC	Dried at room temp then cooked	37.77
FCA	Controlled atmosphere drying and then cooked	55.25
FOR	Osmotic dehydration, room dried and cooked	57.82
FOC	Osmotic dehydration, dried under controlled atmosphere and cooked	54.92
FSR	Steam blanched, room dried and cooked	55.61
FSC	Steam blanched, dried under controlled atmosphere then cooked	58.67
FEL	Fresh leaves	55.73

CONCLUSION

Preprocessing treatments employed in this study affected the colour parameters and free radical scavenging ability of resulting broths in varying magnitude. The highest lightness index, L*, was found in samples subjected to combined osmotic dehydration, room temperature drying and cooking. The highest negative value of the greenness index, a*, was found in sample broths subjected to the cooking treatment. The FCE, FOR, FSC treatment combinations increased the free radical scavenging ability of the resulting broth by 21.8, 3.8 and 5.3%, respectively. On the other hand, the FRC, FCA, FOC, FSR treatments resulted in decreased free radical scavenging ability of the broth by 32.2, 0.9, 1.5 and 0.2%, respectively. The highest free radical scavenging activity (32.2% more when compared to the fresh leave) was recorded when the vegetable was subjected to cooking without other combinations of pre-treatments. The results of this study could be a guide for the selection of the appropriate treatment(s) for nutrition, health and body cells protection.

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