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Determination of Dehydration Pattern and Sensory Properties variation of Blanched and Un-blanched, Cut and Whole *Moringa olifera* Leaves

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***Abstract*—*Present dietary scenario necessitates exploring the possibility of incorporating novel ingredients that can improve quality in commonly consumed foods.Moringa olifera is abundant in sub-tropical regions that is an excellent source of beta carotene and other vitamins, minerals and amino acids.This study was conducted to determine effect of cutting and steam blanching before dehydration on organoleptic properties and dehydration pattern of Moringa olifera leaves. Fresh leaves were harvested from same location and dehydrated under four conditions according totwo factor factorial design. Organoleptic properties of dehydrated leaveswere compared forfour sensory attributes ascolour, aroma, taste and overall acceptability using five point hedonic scale. L*a*b* values were determined and drying curves were plotted for each treatment combination. Results revealed that, blanching and cutting can darker the colour and alter the flavour of dehydrated products.Further the surface area of the leaves have a significant effect in dehydrating time while blanching can accelerate the rate of moisture removal.*

***Keywords*— Blanching, Cutting, Dehydration, Moringa, Sensory properties.**

I. INTRODUCTION

*Moringa oleifera*plantis the most widely cultivated species among the 13 known species [1] of *Moringaceae* family [2],[3].While native to the Indian sub-continent, *Moringa* has spread throughout the tropical and sub-tropical regions of the world such as Africa, tropical America, Sri Lanka, Mexico, Malaysia, Phillipine Islands etc. [2], [3].

Moringa is known in different regional names throughout the world such as Benzolive tree (Haiti), Horseradish tree (Florida), Nébéday (Senegal), Drumstick tree (India), Kelor, Marango, Mlonge, Mulangay, Saijihan, Sajna etc. [4]. In Sinhala it is called "Murunga" and in Tamil it is called "Murungakai" [5]. *Moringa* grows mostly in dry zone in Sri Lanka such as Jaffna, Kalpitiya, Mannar, Puttalam and Hambantota [6].

Several varieties of *Moringa* such as *Rann murunga* (local variety), *Jaffna* and *Chavakachcheri murunga* are widelygrown in Sri Lanka. In addition several hybrid types such as Kalpitiya, V 19 and V 16 have also been introduced [5] for local farmers.

Various studies have proved that *Moringa olifera* leaves have numerousnutritional valuesincluding vitamins, minerals and amino acidsmaking it a virtually ideal dietary supplement [7],[8], [9]. As such, the leaves have been used to combat malnutrition, especially among infants and nursing mothers [7], [10], [11].

Since there are antioxidant and phytochemical properties have been found in*Moringa olifera*leaves, it is capable of being identified for having lots of medicinal uses, which have been recognized in the Ayurvedic andUnani systems of medicine [12]. Considering as a natural anticancer, antihypertensive, diuretic, antispasmodic, antiulcer, antihelmintic, antibiotic, detoxifying and immune building agent and also possess some cholesterol lowering activities [11].

Drying can be considered as the most commonly used method for preservation, packaging, transportation and distribution of leafy vegetables.The principle of preservation by dehydration process can be considered as to remove the moisture content of a material to a level where microorganism may not be able to grow and spoil it [8].

During the drying process there can be lots of losses in the sphere ofnutritional, physical and chemical composition of leaves [13]. Therefore, to minimize drying losses various pretreatments such as blanching can be used.

Blanching is important mainly for the purpose of inactivating enzymes that can cause undesirable changes to reduce the quality of the final product; modifying

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texture; preserving color, flavour, and nutritional value of the product (retain certain nutrients such as vitamins; and removing trapped air[8].According to a research done by TitiMutiara K et al., [19] steam blanching had been able to show the highest amino acid content than un-blanched, hot water blanched and hot water blanch with sodium bicarbonate.

Thus, the current study was carried out to determine the effect of cutting and steam blanching before dehydration on the organoleptic properties and dehydration pattern of *Moringa olifera* leaves.

II. MATERIALS AND METHOD

2.1 Sample preparation

Fresh plant materials (leaves with the stalks) were taken from the same plant for the whole study.

Thereafter, fresh, undamaged, leaves were selected while discarding the bruised, discolored, decayed and wilted leaves. Fresh leaves were cut from the main branches and wash with distilled water. The washed leaves were then spread overa stainless steel meshracks for 15 min to drain out the water. Thereafter, the leaves weredehydrated in ahot air ovenat 48±2ºC for 150 minutes considering two major variables as, Cutting (a) and blanching (b) under two factor factorial design as,

a_0b_0 (Oven dry whole leaves without steam blanching), treatment No 127

a_0b_1 (Oven dry whole leaves withsteam blanching for 4 minutes), treatment No 327

a_1b_0 (cut (about 1*0.4cm)& oven dryleaves without steam blanching), treatment No 227

a_1b_1 Cut & oven dry (about 1*0.4cm)withsteam blanching for 4 minutes), treatment No 427.

2.2 Sensory evaluation

The sensory evaluation was performed by evaluatingfour major sensory attributes namelycolour, Intensity of *Moringa* aroma, Intensity of *Moringa* taste and Overall acceptability using a five point hedonic scale. A semi trained sensory panel with thirtymembers wasparticipated for this study.

2.3 Analysis of the colour variation in each treatment combination

Each sample was loaded tightly into the Granular-Materials Attachment (CR-A50) and the colour was measured using the Chromameter (Konica Minolta, CR-400 Head) as L*, a*, b* colour values. Test was carried out three times per each sample.

2.4 Plotting the drying curve

Initially moisture content and weight of the fourleaves samples were determined and those samples were kept in the hot airoven at 48±2ºC for 180 minutes while replicating each sample thrice. The weights of the each sample were recorded at every 15 minute intervals. Finally, drying curves were plotted"Moisture content (%) verses Time (minutes)".The calculations were based on the equations (1) and (2).

: Weight loss % after t time = $\frac{Mi-Mx}{Mi} * 100$ (1)

Where, Initial weight of dish with sample (Mi) and Weight after t time period (Mx).

If the answer of the equation (1) is w, equation (2) can be applied to calculate the moisture content at each 30 minutes interval.

: Moisture % after t time period = $Initial\ moisture\ content - w(2)$

2.5 Statistical analysis

The collected data pertaining to the non-parametric were analyzed according to Kruskal-Wallis and Mann Whitney U test and parametric data according to two sample t test using Minitab 17 Statistical Software package and graphical representation was done using Microsoft Office Excel 2010.

III. RESULTS AND DISCUSSION

3.1Organoleptic properties of the four dehydrated leaves samples.

Organoleptic properties pertaining to colour, Intensity of *Moringa* aroma, Intensity of *Moringa* taste and Overall acceptabilityof for dehydrated *Moringa* leaves samples are given in table 1.

Table.1:The mean rank of the four dehydrated Moringa leaves samples with respect to the four sensory attributes.

Sample number	Colour	Intensity of Moringa aroma	Intensity of Moringa taste	Overall Acceptability
127	49.4^{a}	73.1^{a}	74.5^{a}	38.1^{a}
227	71.8^{b}	95.5^{b}	91.4^{b}	59.5^{b}
327	89.6^{c}	49.9^{c}	48.9^{c}	94.5^{c}
427	31.3^{d}	23.6^{d}	27.2^{d}	49.9^{ab}

^{a,b,c,d} Values in the same row with different superscripts are significantly different at 0.05 significant level.

According to sensory evaluation (table 1), all four samples are significantly different in colour, intensity of *Moringa* aroma and intensity of *Moringa* taste ($P \leq 0.05$). When considering the overall acceptability, sample number 127 and 427 had shown no significant different ($P \geq 0.05$) and also sample number 227 and 427 had shown no significant different ($P \geq 0.05$).

3.2 Chromameter values of the four dehydrated *Moringa* leaves samples

Mean Chromameter colour values of the dehydrated *Moringa* leaves samples are givenin table 2.

Table.2: Mean Chromameter colour values of the dehydrated Moringa leaves samples

Sample	Average colour values from Chromameter		
	L*	a*	b*
a_0b_0	44.82 ± 0.06	-6.79 ± 0.12	10.71 ± 0.11
a_1b_0	44.74 ± 0.10	-6.29 ± 0.07	10.79 ± 0.06
a_0b_1	38.54 ± 0.03	-3.46 ± 0.02	5.58 ± 0.05
a_1b_1	37.96 ± 0.16	-2.74 ± 0.11	4.93 ± 0.08

As givenin table 2, the lightness of the four samples are decliningproving that the samples become darker. Whereas, all a* values are negative representing the green colour of the samples and the values are more closer to the center representing the reduction of the purity of the green colour (Chromacity). All b* values are positive representing the yellow colour and the values are closer to the center representing the reduction of the purity. According to the results, the un-blanched samples having lighter green colour than the blanched samples which imparts a dull green colour.

The natural green colour of leaves is due to presence of chlorophyll which directly relates to magnesium. During drying, the chlorophyll molecules are converted to pyropheophytin and pheophytin. Therefore, at highertemperatures greenness is reduced. Thus, visually, dark green colour of the leaves convert into dull green-yellow due to degradation of chlorophyll. Same observation has been reported by Ali et al., [14].

According to both sensory evaluationand chromameter colour values,colour of the samples after dehydrating had variations. Likewise, sample "a_1b_0" had darker colour than "a_0b_0", while "a_1b_1" had darker colour than "a_1b_0"and also when comparing blanched samples with un-blanched samples, blanched samples had shown darker and thermally damagedcolour than un-blanched samples. The colour values from the Chromameter also proved that observation. When considering the *Moringa* aroma and taste, "a_1b_0" had more intense *Moringa* aroma and taste (raw leafy taste with a little pungency but highlighting the characteristic flavors of *Moringa* more) than "a_0b_0" and also when comparing the blanched samples with un-blanched, blanched samples had less raw *Moringa*flavour than the un-blanched samples and had developed a flavour like in tea leaves (specially the aroma).

3.3 Plotting the drying curve

Fig 1to 4 represents the drying curves for the four dehydrated *Moringa* leaves samples. And table 3 represents the moisture contents of the four samples initially and after dehydrating at 48±2ºC for 180 minutes.

Table.3: Initial and final moisture content of the four dehydrated Moringa leaves samples.

Sample	Initial moisture % (w/b)	Moisture % after 180 minutes (w/b)
a_0b_0	76.16 ± 0.20	3.26 ± 0.72
a_1b_0	77.66 ± 0.24	2.50 ± 0.47
a_0b_1	81.47 ± 0.36	1.07 ± 0.08
a_1b_1	80.13 ± 0.33	2.39 ± 1.13

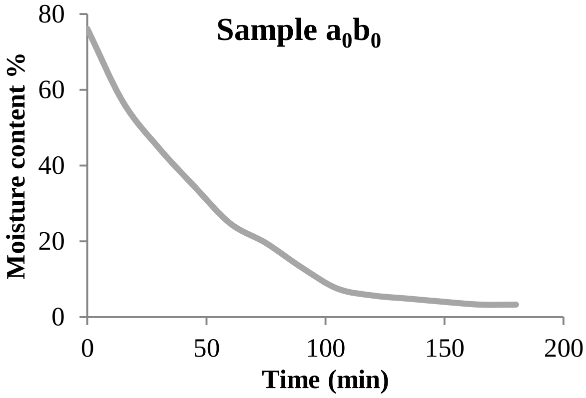

Fig.1: Drying curve for sample a_0b_0

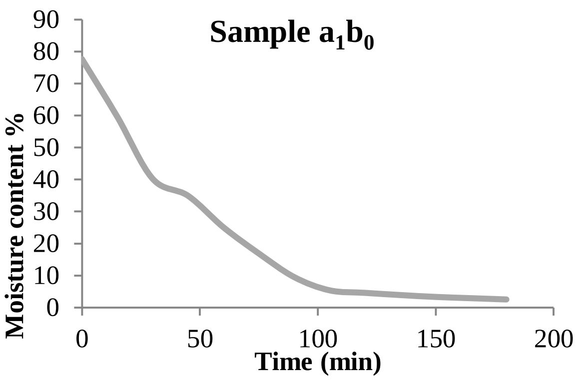

Fig. 2: Drying curve for sample a_1b_0

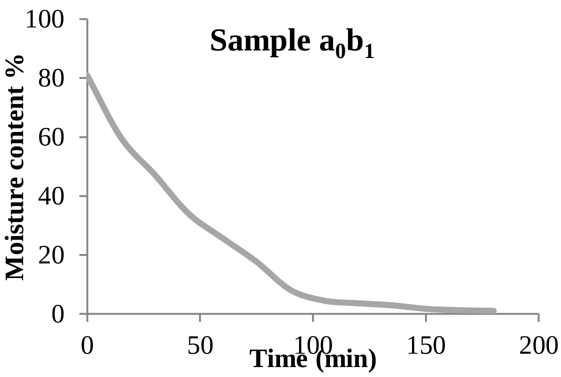

Fig.3:Drying curve for sample a_0b_1

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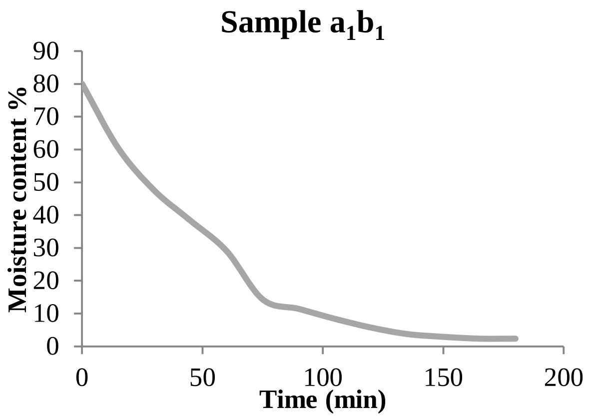

Fig.4: Drying curve for sample a_1b_1

The graphs in fig. 1, 2, 3, and 4 clearly indicate that initially only a minor change in moisture content occurs representing the preheat period. This can be happened because all the heat provided in the drying air is used to heat up the material to the drying temperature. Then after a certain period, it could be observed that water evaporated from the product at rather a constant rate which can be named as the constant heat period. During this period, the mass of water start to evaporate from the surface in equal intervals of time [15]. Then the drying rate began to reduce (Falling rate period) which can identify clearly in all the four graphs. This can be happened because it takes more time for internal moisture to move to the surface [15]. The point at which the drying rate starts to reduce can be declared as the Critical moisture content of the particular product.

Leaves in all four samples were dehydrated at same time under the same conditions such as drying temperature, air velocity, humidity of the air surrounding the food item etc.making the only variations between the four samples are blanching step and surface area.

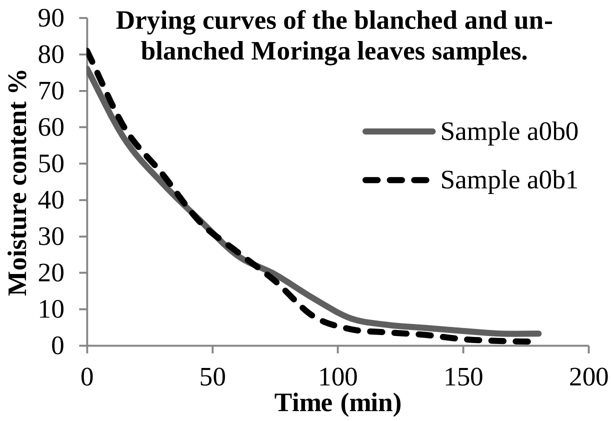

Fig.5: Comparison of the drying curvesof the blanched and un-blanched Moringa leaves samples.

Fig 5 and 6 declares the variation of the dehydrating pattern with respect to the two treatment variables of cutting (a) and blanching (b).

According to the fig 5, moisture content of the blanched sample reducesto the critical moisture content within a short time span than the un-blanched sample. And the weight loss is higher in blanched samples compared to the un-blanched. According to Greve et al. [16] and Waldron et al. [17], cells lose their wall integrity during blanching process and thus the water removal is higher. Apart from that, certain volatile compounds and water soluble nutrients such as certain vitamins like vitamin C and minerals can be loss during blanching process which can also reduce the dry matter content of the samples up to some extent. Hence weight loss in blanched samples is higher than that of un-blanched samples.

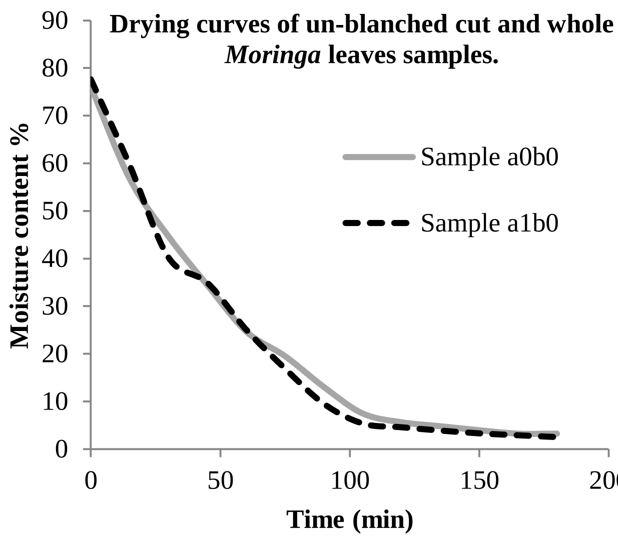

Fig.6: Comparison of the drying curvesof the un-blanched cut and whole Moringa leaves samples.

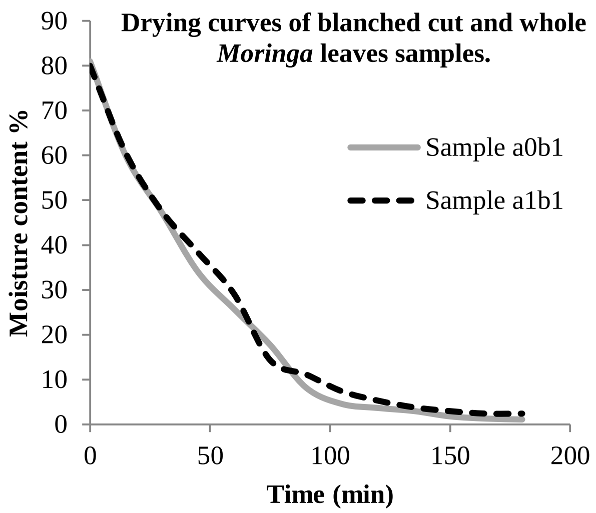

Fig.7: Comparison of the drying curvesof the blanched cut and whole Moringa leaves samples.

When considering the particle size, if the particle size is smaller, larger the surface area which may lead toincrease the speed of heat and mass transfer rate reducing the time required to reach the critical moisture content that can be identified clearly in both fig 6 and 7.

The reason for this can be described as the larger surface area provides more surface in contact with the heat medium and more surface from which moisture can be escaped. And also smaller the particles it can reduce the distance that heat can transfer to the center and reduce the distance that the moisture have to travel to reach the surface [18].

IV. CONCLUSION

When considering the four treatment combinations, the colour and aroma can be affected from cutting the *Moringa* leaves before dehydration by improving characteristic *Moringa*flavour. And further, blanching process can also darken the colour and alter the flavour of the leaves.

According to the drying curve, it can be concluded that the surface area of the samples and blanching can have a significant effect in dehydrating time while increasing the rate of moisture removal.

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