EFFECTS OF DRYING METHODS ON THE NUTRIENT COMPOSITION AND TOTAL MICROBIAL LOAD OF *MORINGA OLEIFERA* LEAF

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Abstract

There are many varieties of green leafy vegetables which are nutritious and readily available. More often than not, many of the plants are usually discarded and not used for human consumption. One of such leaf, which is a rich source of nutrients but still under exploited is Moringa oleifera, also known as drumstick. The study aimed at investigating the effects of different methods on the nutritive value and microbial status of Moringa oleifera leaf. Moringa oleifera leaves were collected from the University of Ibadan environs; Crude protein (%), crude fibre (%), ether extract (%) and ash (%) were analysed for. Bacteria on the leafy plant were also investigated . The results showed that heat had effect on the protein content of the oven-dried and sun-dried samples. Air- dried samples had highest protein content (26.47%), while the least value (19.25%) was obtained from oven-dried samples. Maximum amount of Ca, Fe, and P were recorded in the air-dried samples. The microbial contamination (load) was higher (13.9 x 10^4) in sun-dried samples compared with the oven drying methods (10.4 x 10^4 $_{cfu/g)}$; air 8.6 x 10^4 $_{cfu/g}$). This could be due to environmental factors,coupled with the methods of drying.. Moringa oleifera leaves should be dried in an area protected from direct sunlight in order to prevent loss of nutrients. It should also be shielded away from cross contamination by dust and pests.

Key words: *Moringa oleifera*, proximate analysis, microbial load, drying methods.

EFFETS DES MÉTHODES DE SÉCHAGE SUR LA COMPOSITION EN NUTRIMENTS ET LA CHARGE MICROBIENNE TOTALE DES FEUILLES DE *MORINGA OLEIFERA*

Résumé

Il existe de nombreuses variétés de légumes à feuilles vertes qui sont nutritifs et facilement disponibles. Le plus souvent, de nombreuses plantes sont généralement jetées et non utilisées pour la consommation humaine. L'une de ces feuilles, qui est une riche source de nutriments mais encore sous-exploitée, est le Moringa oleifera, également connu sous le nom de pilon. L'étude visait à étudier les effets de différentes méthodes sur la valeur nutritive et le statut microbien de la feuille de Moringa oleifera. Des feuilles de Moringa oleifera ont été récoltées dans les environs de l'Université d'Ibadan ; Les protéines brutes (%), les fibres brutes (%), l'extrait d'éther (%) et les cendres (%) ont été analysés. Les bactéries présentes sur la plante feuillue ont également été étudiées. Les résultats ont montré que la chaleur avait un effet sur la teneur en protéines des

échantillons séchés au four et au soleil. Les échantillons séchés à l'air avaient la teneur en protéines la plus élevée (26,47 %), tandis que la valeur la plus faible (19,25 %) a été obtenue à partir d'échantillons séchés au four. La quantité maximale de Ca, Fe et P a été enregistrée dans les échantillons séchés à l'air. La contamination microbienne (charge) était plus élevée (13,9 x 10^4) dans les échantillons séchés au soleil par rapport aux méthodes de séchage au four (10,4 x 10^4 $_{cfu/g}$) ; air 8,6 x 10^4 $_{ufc/g}$). Cela pourrait être dû à des facteurs environnementaux, couplés aux méthodes de séchage. Les feuilles de Moringa oleifera doivent être séchées dans une zone protégée de la lumière directe du soleil afin d'éviter la perte de nutriments. Il doit également être protégé de la contamination croisée par la poussière et les parasites.

Mots-clés : *Moringa oleifera*, analyse immédiate, charge microbienne, méthodes de séchage.

آثار طرق التجفيف على التركيب الغذائي وإجمالي الحمل الميكروبي لأوراق المورينغا أوليفيرا

الملخص

هناك العديد من أنواع الخضروات ذات الأوراق الخضراء المغذية والمتوفرة بسهولة. في كثير من الأحيان ، عادة ما يتم التخلص من العديد من النباتات ولا تستخدم للاستهلاك البشري. واحدة من هذه الأوراق ، والتي تعد مصدرًا غنيًا بالمواد المغذية ولكن لا تزال قيد الاستغلال ، مورينجا أوليفيرا ، المعروف أيضًا باسم أفخاذ. هدفت الدراسة إلى معرفة تأثير الأساليب المختلفة على القيمة الغذائية والحالة الميكروبية لأوراق المورينجا أوليفيرا. تم جمع أوراق المورينجا أوليفيرا من ضواحي جامعة إبادان. تم تحليل البروتين الخام (٪) والألياف الخام (٪) ومستخلص الأثير (٪) والرماد (٪) من أجل. كما تم فحص البكتيريا الموجودة على النبات الورقي. أظهرت النتائج أن الحرارة كان لها تأثير على محتوى البروتين للعينات المجففة بالفرن والمجففة بالشمس. العينات المجففة بالهواء احتوت على أعلى محتوى بروتين (26.47٪) بينما أقل قيمة (19.25٪) تم الحصول عليها من العينات المجففة بالفرن. تم تسجيل أقصى قدر من الكالسيوم والحديد والفوسفور في العينات المجففة بالهواء. كان التلوث الميكروبي (الحمل) أعلى (13.9 × 104) في العينات المجففة بالشمس مقارنة بطرق التجفيف بالفرن (10.4 × 104 قدم مكعب / جم) ؛ الهواء 8.6 × 104 كفو / ز). قد يكون هذا بسبب العوامل البيئية ، إلى جانب طرق التجفيف .. يجب تجفيف أوراق المورينجا أوليفيرا في منطقة محمية من أشعة الشمس المباشرة من أجل منع فقدان العناصر الغذائية. يجب أيضًا حمايته بعيدًا عن التلوث المتقاطع بالغبار والآفات.

الكلمات المفتاحية: المورينجا أوليفيرا ، التحليل التقريبي ، الحمل الجرثومي ، طرق التجفيف.

Introduction

Green leafy vegetables and fruits are naturally rich source of iron and other essential nutrients (Pallavi and Dipika, 2010). *Moringa oleifera*, fondly regarded as a "miracle tree" has been found to be of numerous medicinal values (Ghasi *et al*, 2000). It is hypocholesterolemic in nature and very potent in the treatment of heart disease and obesity (Olugbemi *et al,* 2010).

Moringa leaves can be eaten fresh, cooked, or stored as dried powder for many months without refrigeration, and reportedly without loss of nutritional value. *Moringa* is especially promising as a food source in the tropics because the tree is in full leaf at the end of the dry season when other foods are out of season (Jed and Fahey, 2008).

Drying is a common practice used in most parts of Africa to preserve vegetables (Lyimo *et al*, 1991) with an appreciable impact on the microbiological value. The nutrient composition

of a leaf is affected both by the age of harvesting and the heat cure applied (Norton, 1994).

Materials and Methods

Sampling: Fresh leaves of *Moringa oleifera* were plucked off the matured moringa tree from the garden of the department of Agronomy, University of Ibadan and taken to the laboratory for processing and analyses.

Pulverization*:* Dried leaves from the three treatments were crushed into powder using a blender (Peter, 2010)**.** Pulverized samples were stored in clean, dry and sterile sample bottles.

Analyses*:* Proximate composition was done using (AOAC (2021); Mineral composition from dry ashing method of Mebrahtu and Tenaye, (1997) and Total microbial count as adopted by Olutiola, *et al*, (1998).

Statistical analysis was completely randomized design and means were separated by Duncan multiple test.

Result

Table 1 shows the results of the proximate analysis obtained in this study. Significant ($p<0.05$) variations were observed across the treatments in terms of % DM content (15.56, 13.05, 12.64) and CF (15.0, 11.0, 8.0). Crude protein varied significantly ($p<0.05$) between air-dried *Moringa oleifera* leaves (MoL) and MoL subjected to other drying methods, while oven-dried sample showed no significant ($p>0.05$) difference.

Table 1: Proximate composition of Moringa oleifera leaf

Sample	% Dry matter	% Crude protein	% Crude fiber	% Fat	% Ash
Oven-dried	15.56a	19.25b	15.00a	10.00b	10.00b
Sun-dried	13.05b	19.47b	11.00b	12.00a	12.00a
Air-dried	12.64c	26.47a	8.00c	13.00a	13.00a
SEM	0.04	0.06	0.33	0.33	0.33

Means with the same superscript are not significantly different, SEM = standard error

Table 2: Mineral composition of Moringa oleifera leaf subjected to different drying methods

Sample	P (%)	K	Ca	Na(mg/l)	Mn(mg/l)	Fe(mg/l)	Mg(mg/l)	Cu(mg/l)	Zn(mg/l)
Oven-dried	0.0088^{a}	2.9200^{a}	2.0450^{c}	4.7200^{c}	0.6000^{a}	11.7400^{b}	53.3000^{b}	0.0950^{b}	0.4380^{c}
Sun-dried	0.0070^{b}	2.0150^{b}	2.2750^{b}	6.1100^{a}	0.6700^{a}	16.8000^{a}	43.2000^{c}	0.1750^{a}	0.5620^{a}
Air-dried	0.0066^{c}	1.8300^{c}	2.3400^{a}	5.5400^{b}	0.7100^{a}	16.9000^{a}	59.6000^{a}	0.0740^{c}	0.5000^{b}
SEM	6.667	0.005	0.006	0.007	0.020	0.055	0.273	0.002	6.667

Means with the same superscript are not significantly different, SEM = standard error of means

Table 3: Total microbial load and colour observed on Moringa oleifera leaf before and after drying

Sample	Total microbial load (Cfu/mL)	Colour
Fresh	1.8×10^{4}	Green
Oven-dried	10.4×10^{4}	Brown
Sun-dried	13.9×10^{4}	Light brown
Air-dried	8.6×10^{4}	Light green

Means with the same superscript are not significantly different, SEM = standard error of means

Discussion

The highest value for crude protein (26.47%) was obtained from the air-dried *Moringa oliefera* leaf which does not coroborate the report of Pallavi and Dipika, (2010) who recorded 23.67% from the oven-dried moringa sample. The protein

content of *Moringa oleifera* leaf powder was a little higher than the protein content of many pulses such as moth beans, soybeans, Rajmah and others which contain (22 - 24%) protein. Thus, becoming a good source of protein. The protein content of the leaf samples was higher than many of the commonly consumed green leafy vegetables such as spinach (2%), and mint (4.8%). The fat content of the leaf samples obtained in this study were higher than the values obtained by Pallavi and Dipika, (2010) who reported values for fat ranging from (6.98 – 7.03) in their work. The results obtained for proximate analysis in this work agrees with the reports of Yadav and Sehgal, (1997) and Adetona and Omodara, (1994) that heat treatment had an adverse effect on the protein content of the MoL. The results of the mineral analysis showed that the leaf samples after drying became a concentrated source of all the nutrients. The results are in agreement with the studies done by Lakshmi and Vimla (2000) which showed that the leaves retained good amounts of protein, fiber and calcium in the various samples of the leaves dried by sun drying and cabinet drying. Similar findings were reported by Kowslya and Vidhya (2004) and Jemina Beryl and Bhavani 2004 in the dehydrated green leafy vegetables of cauliflower. As far as carbohydrate is concerned, green leafy vegetables are not considered as a good source of carbohydrate but after dehydration the carbohydrate content of the leaves was comparable with many of the carbohydrate rich cereals and vegetables. Wheat (69.4%), Potato (22.6%), turnip (9.4%). There was a significant increase in the mineral and vitamin content of the leaf samples after dehydration. Micronutrient deficiency also referred as hidden hunger is a major problem in the developing countries which leads to severe consequences affecting the human resources, the major power of the developing countries.

Iron, calcium and phosphorus increased manifolds in the dehydrated samples.

Calcium varied significantly ($p>0.05$) among the three drying methods with the highest value obtained from the air-dried sample (2.3%). This is similar to the report of Lakshmi and Vimla, (2000). Oven-dried moringa leaf varied significantly ($p>0.05$) in terms of iron (Fe) content with other two methods of drying. Values obtained in terms of Ca and Fe for air-dried samples were similar to those reported by Lakshmi and Vimla, (2000) and Fuglie (2001).

The iron content of the leaf powder prepared by different methods of drying was in the range of 11.74 – 16.90 mg/ 100 g leaf powder. Maximum amount of iron content was detected from the air-dried sample (16.90mg/ 100 g leaf powder) followed by sun dried sample (16.80 mg/ 100 g leaf powder) and it was lowest in oven dried sample (11.74 mg/ 100 g leaf powder). This result is in sequence with that of Pallavi and Dipika, (2010) who also obtained the highest value iron from the shadow dried samples and least value from oven dried sample in their work.

Fresh *Mo* leaf showed non-viable count as it recorded $1.8x10^4$ colonies while significant variation was observed ($p>0.05$) among the three treatments. Oven-dried and sun-dried samples recorded higher counts probably due to the presence of some active ingredients (antibiotics) were heat-labile. *Moringa oleifera* leaf contains Pterygospermin which had been reported to show antibacterial activity against both gram positive and gram-negative organisms (Sofowora, 1982).

Conclusion

The study showed that heat treatment drastically altered the pigmentation of *Moringa oleifera* leaves from attractive green to dirty brown. Air drying method could retain the protein content of the leaf and prevent lipids oxidation with an appreciable increase in dietry fibre. Air-drying also could enhance the antibiotic property of *moringa oleifera* leaves. *Moringa oleifera* leaves should be dried in an area protected from direct sunlight in order to prevent loss of nutrients. It

should also be shielded away from cross contamination by dust and pests.

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