International Research Journal of Agricultural Science and Soil Science (ISSN: 2251-0044) Vol. 3(3) pp. 75-80, March 2013
Available online http://www.interesjournals.org/IRJAS

Full Length Research Paper

Evaluation of sensory quality attributes and extent of vitamin C degradation in dried pineapple, mango and banana fruit pieces pre –treated with sodium metabisulphite and lemon juice

K.G Masamba[1*], M. Mkandawire[1], J. Chiputula[2], K.S, Nyirenda[2]

[1]Department of Food Science and Technology, Lilongwe University of Agriculture and Natural Resources (LUANAR), P.O. Box 219, Lilongwe, Malawi
[2]Department of Agricultural Engineering, Lilongwe University of Agriculture and Natural Resources (LUANAR), P.O. Box 219, Lilongwe, Malawi

Abstract

Fruits are good source of essential nutrients which is important for human nutrition. However, in view of their perishability and seasonality, fruits need to be processed in more shelf stable products to ensure their availability throughout the year. The current study was carried out to determine the effect of using sodium metabisulphite and lemon juice as pre-treatments on sensory quality attributes and extent of vitamin C degradation in dried pineapple, mango and banana fruit pieces. The sliced fruit pieces 5-8mm thick were dipped in 1% sodium metabisulphite and lemon juice solutions before being dried in a developed food drier with temperatures ranging from 40-45^{o}C for 10-16 hours. Vitamin C was determined before and after drying and subsequently evaluation of sensory quality attributes in terms of flavour, colour, texture and taste was performed using 10 trained panelists. Results showed that the use of pre-treatments reduced the vitamin C degradation with sodium metabisulphite registering the highest reduction and the control samples the lowest reduction. Furthermore, pre-treatments significantly affected ($p<0.05$) affected sensory quality attributes in different ways. However, texture was not affected by the use of pre-treatments. Pre-treated fruit samples had better colour than the control samples. It was further found out that control samples had higher scores in taste and flavour with the exception of pineapples, where the pre-treated samples had a higher score than the control samples.

Keywords: Pineapple, Mango, Banana, Sensory atributes, Vitamin C, Sodium metabisulphite, Lemon juice.

INTRODUCTION

Fruits such as mangoes, bananas and pineapples play a significant role in human nutrition as they provide essential vitamins and minerals. Fruits also contain essential antioxidants which are responsible for scavenging free radicals responsible for various cancers. However, fruits and vegetables are highly perishable and need to be preserved to make them available for a long time (Brett, 1996).

*Corresponding Author E-mail: kmasamba@yahoo.com

The magnitude of losses of horticultural produce such as fruits during post harvest and marketing are acknowledged to be considerable although few studies have accurately quantified these losses (Wills, Mc Glasson, Graham and Joyce, 1998). The extent of fruit post harvest losses in developing countries coupled with limited well defined studies and inadequate or lack of cold chain systems is assumed to be substantially high. The main causes of post harvest losses are physiological (wilting, shriveling and chilling injury etc), pathological (decay due to fungi and bacteria) and physical (mechanical injury). These causes in most instances can be interrelated that is mechanical injury can lead to post

harvest decay in many cases (FAO, 1989 as quoted from Mashal, et al 2012). Post harvest losses are a major challenge for tropical products such as mango, pineapple and banana (Abano, 2010, James, 2003) and a study in South Africa reported that about 50% of the fruits which included bananas, guavas, avocados, oranges and pawpaw were lost mainly due to over-ripening as a consequence of lack of proper storage facilities and appropriate technologies.

Over the years, a number of technologies have been developed to reduce the post harvest losses in perishable products like fruits. Drying is the earliest and oldest technique for making food such as fruits and vegetable storable for a long period of time before they deteriorate. Preservation by drying is based on the fact that spoilage micro-organisms and enzymes that cause chemical changes are functionless without water. The removal of water brings a substantial reduction in weight and volume, minimizing packaging and also storability of the food (Gathambiri, 2005). The world food logistics organization (2010) concluded that appropriate small scale postharvest technologies can reduce fruit and vegetable crop waste, improve income by at least 30% for small holder farmers and marketers. Despite the availability of a number of drying technologies for fruits, producing fruit products of desirable quality attributes is essential to ensure acceptance by consumers. The quality deterioration in dried products can be categorized as nutritional, physical and chemical in nature (McMinn and Magee, 1997) and removing of moisture during drying is attributed to these changes on the dried products (Karim, 2005). Karim further reported that browning and disruption of tissues of dried fruits owing to presence of polyphenols are the physical characteristics and one of the setbacks in fruit drying. Drying has also been reported to affect unstable vitamins such as vitamin C. Degradation rate of vitamin C is affected by several factors such as temperature, water activity, pH and metal ions (Fennema, 1993) and according to Smart (1995), drying of fruits and vegetables results in losses of vitamin C.

The current study was carried out to assess the effect of using pre-treatments namely sodium metabisulphite and lemon juice on sensory quality attributes namely flavour, texture, colour, taste and the extent of vitamin C content degradation in dried mango, banana and pineapple fruit pieces.

MATERIALS AND METHODS

Study area

The study was carried out in the department of food science and technology at Bunda College campus (formerly, a constituent college of the University of Malawi) of the newly established Lilongwe University of Agriculture and Natural Resources (LUANAR)

Sample collection and preparation

All the fruits (pineapples, mangoes and bananas) used in the study were purchased from Lilongwe market and all the fruits were indigenously grown. Only good quality fruits were chosen for the study and the choice were based on the colour, firmness and for the mangoes, half ripe mangoes were chosen. The collected fruit samples were stored at room temperature and were processed within 48 hours after being purchased. The fruits were washed using tap water, peeled depending on fruit type and sliced to thickness of 6-8mm with the exception of banana fruit which was sliced to 5mm.

Sample treatment

The neatly sliced fruit pieces were dipped in 1% sodium metabisulphite (w/w) and 1% lemon juice (v/v) solutions for 5-10 minutes. The 1% lemon juice solution was prepared from a freshly squeezed concentrated or undiluted lemon juice from the indigenously grown lemons procured from the local markets. The squeezed concentrated or undiluted lemon juice was first filtered using a muslin cloth before the 1% lemon juice solution was made. The pre-treatment solution was later drained off and the sliced fruit pieces were wiped with clean towels before drying. Control samples were also prepared for all the treatments.

Fruit pieces drying

The pre-treated and control fruit samples were dried in a food drier recently constructed by the agricultural engineering department at Bunda College. The drier was made of blockboards and fitted with fans for heat generation, drying trays and temperature and relative humidity sensors. Drying temperature, humidity and air speed were recorded and the temperature ranged from 40-45^{o}C while relative humidity ranged from 25-45% during the drying period. The samples were dried until done and doneness was confirmed when they become rubbery or flexible. When drying was completed, the dried fruit pieces were allowed to cool and were packed into transparent zip lock bags and labeled accordingly. The whole drying process took 10-16 hours for different fruit samples used.

Vitamin C determination

Vitamin C determination in pre-treated fruit and control samples was done before and after drying to determine

the extent of vitamin C degradation in dried fruit samples. Determination of vitamin C was done according to titration method as described in AOAC (2000).

Sensory quality attributes evaluation

Descriptive sensory test to evaluate sensory quality attributes was done by using 12 trained panelists from the students pursuing studies in food science and nutrition at Bunda College campus of the Lilongwe University of Agriculture and Natural Resources (LUANAR). The trained panelists were tasked to evaluate the sensory attributes of dried fruit pieces namely flavour, taste, texture and colour using appropriate descriptions which ranged from 1 being poor and 5 being excellent for taste and colour. The descriptions for flavour had additional describing words to reflect the typical flavours of the fruit pieces while for texture, the descriptions ranged from 1 being tough and 5 being tender.

Data analysis

All the data obtained from vitamin C determination and sensory quality attributes was analysed using statistical package for social sciences (SPSS). Intra-pair significant differences especially for sensory quality attributes were determined using Tukey's tests at 5% level of significance.

RESULTS AND DISCUSSIONS

Vitamin C content in untreated fresh and treated dried fruit pieces

Results for vitamin C content for both the untreated fresh and treated dried fruit pieces are presented in Table 1. Different values for vitamin C contents in pineapple, mango and banana fruits have been obtained from the analysis. For all the three types of fruits, values for vitamin C have been either close or different to previously reported findings from other authors and these differences may be attributed to fruit cultivar, maturity stage, vitamin C extraction methods and determination methods as reported by Y. Hernandez (www.icia.es/icia/download/postcosecha/vitamin c.pdf). However, with the exception of mango fruits, where they obtained value in this study was far below the one presented by Hernandez using different methods, the values for vitamin C in banana and pineapple fruits were close to the ranges presented. The vitamin C content for the fresh banana fruit in this study (13.00±0.88mg/100g) was different than the one reported by Cano, et al (1997) who found a higher value of 33.20mg/100g demonstrating that differences may be present and may be attributed to a number of factors. For pineapple fruit, the obtained value of 32.50mg/100g was slightly lower than the one reported by Masamba (2013) of 34.7mg/100g from the same indigenously grown pineapples from the southern district of Mulanje in Malawi. It is an established fact that vitamin C is heat sensitive vitamin and it was not therefore surprising to observe that the dried fruit pieces registered a decline in vitamin C after the drying process. The extent of vitamin C degradation was high in the control samples than the sodium metabisulphite and lemon juice treated samples. The observed degradation of vitamin C in the dried samples is in agreement with findings of Dorofejeva et al., (2011) who reported that vitamin C is the least stable of all vitamins and it can be easily degraded during processing and storage and concluded from their study that vitamin C content loss in cranberries processed by microwave vacuum drying method comparing with drying in convective cabinet type dryer was smaller. This trend in vitamin C degradation is also in consistent with findings of Marfil et al., (2008) who reported that the degradation rates of vitamin C were dependent on samples treatment before drying, as well as on drying temperature and that lower degradation rates were observed in osmotically pre-treated whole tomatoes, whereas higher degradation rates occurred in halved tomatoes. The results also showed that when comparisons are made between sodium metabisulphite and lemon juice treated samples, vitamin C is better retained in sodium metabisulphite treated samples than in lemon juice treated samples regardless of the fruit type. The use of sodium metabisulphite has proved to be more effective in reducing the degradation rate of vitamin C in the dried fruit pieces and this protective nature of sodium metabisulphite on vitamin C has also been reported in similar previous studies (Bhardwaj and Kaushal (1990), Karim (2005).

Sensory quality attributes in dried pineapple fruit pieces

Results for the sensory quality attributes in dried pineapple fruit pieces are presented in Table 2. From the results, flavour and texture were not significantly affected by the use of sodium metabisulphite and lemon juice as pre-treatments to the fruit pieces before being dried. However, the pre-treated fruit pieces had higher scores than the control samples and this could be attributed to reasons as presented by Abano (2010) who reported that honey treated dried samples and ascorbic treated samples scored more in texture than the control samples implying that sodium metabisulphite and lemon juice contributed to the protection of the texture loss. These findings are also in consistent with findings of Panagiotou (1998) who found out that vitamin C and honey treated samples scored higher in texture than control and further

Table 1. Vitamin C content of fresh and dried fruits for the different treatments (mg/100g)

Fruit treatment	Fruit type		
	Pineapple	**Mango**	**Banana**
Fresh fruit (untreated)	32.50±1.00	26.00±4.00	13.00±0.88
Sodium metabisulphite treated	16.82±2.00	12.00±0.50	6.40±1.00
Lemon juice treated	11.00±0.30	7.00±1.60	5.10±0.40
Control	6.52±2.00	5.08±0.75	3.74±0.80

Table 2. Sensory quality attributes of dried pineapple pieces

Fruit treatment	Flavour	Texture	Colour	Taste
Sodium metabisulphite treated	$3.01±1.28^{b}$	$3.17±1.59^{b}$	$4.33±0.49^{b}$	$2.50±1.00^{b}$
Lemon juice treated	$2.50±1.38^{b}$	$3.33±0.65^{b}$	$3.42±1.56^{b}$	$2.25±1.14^{b}$
Control	$3.33±1.30^{b}$	$2.92±1.62^{b}$	$2.33±1.23^{a}$	$4.50±0.52^{a}$

Means in the same column with different letters as superscripts are significantly different ($p<0.05$)

stated that the pre-treatments affects the rate of moisture loss during drying which conserves the tenderness of the outer surface unlike untreated samples when moisture diffusion is very fast hence roughness of the surface of dried pineapples. For the flavour, the results are similar to those outlined by Gherard et al (1994) who reported that pineapples contain sucrose, fructose and glucose in concentrations which gives it a good taste, which in combination with some acids and other compounds determine the typical flavour of pineapple fruit The colour and taste of the dried samples were significantly affected by the pre-treatments. Higher scores for colour were registered in pre-treated samples than in control samples while the scores for taste were high in control samples as compared to pre-treated samples. The higher scores in colour for pre-treated samples are in line with findings of Latapi and Barret (2005) who concluded in their study that dipping tomatoes in 6% or 8% sodium metabisulphite for 5 minutes before drying established the best colour. The lowest scores in taste for the pre-treated samples could be attributed to the impact of the pre-treatments on the original taste of the pineapple despite the fact that low concentration levels were used and this assumption is in agreement with findings of Abano (2010) who reported that where fruits were treated with honey, salt, vitamin C, it was found out that salt treated samples scored the lowest of the treatments.

Sensory quality attributes in dried mango fruit pieces

The sensory quality attributes in dried mango pieces are presented in Table 3. Texture was not significantly affected by the pre-treatments while there were significant differences in flavour, colour and taste. The results on texture are similar to those reported by Mozumder, et al (2012) who also found out that there were no significant differences between control and treated samples regarding texture. For flavour, higher scores were obtained for control samples though when comparisons were made between the control samples and sodium metabisulphite treated samples, no significant differences while when two samples were compared with the lemon juice treated samples, significant differences were observed. The pre-treated samples registered higher scores than control samples in colour and similar results were reported by Mozumder et al (2012) who found out that potassium metabisulphite and calcium chloride treated showed better colour than the other samples. These results on colour are also in consistent with those reported by Bhardwaj and Kaushal (1990). Significant differences were also observed in taste where the control samples had a higher score compared to the pre-treated samples and this could also be attributed to the previously stated reasons of the impact of the pre-treatments on the original taste of the mango which have been backed up by findings of Abano (2010) who reported that where fruits were treated with honey, salt, vitamin C, it was found out that salt treated samples scored the lowest of the treatments.

Sensory quality attributes in dried banana fruit pieces

The sensory quality attributes in dried banana fruit pieces are presented in Table 4. Just like in mangoes, texture was not significantly affected by the pre-treatments while significant differences were observed for flavour, colour and taste. There were no significant differences in flavour for sodium metabisulphite and lemon juice treated samples and the control samples had the highest score. For colour, the pre-treated samples had higher scores as compared with control samples. Additionally, the sodium metabisulphite treated samples had higher scores compared to the lemon juice treated implying the colour

Table 3. Sensory quality attributes of dried mango pieces

Fruit treatment	Flavour	Texture	Colour	Taste
Sodium metabisulphite treated	3.17±0.94[a]	2.83±1.53[a]	4.42±1.17[b]	3.83±0.72[b]
Lemon juice treated	2.92±1.24[b]	3.00±1.72a	4.33±0.89[b]	3.00±1.60[b]
Control	3.67±1.37[a]	2.75±1.14[a]	2.33±1.37[a]	4.42±0.80[a]

Means in the same column with different letters as superscripts are significantly different ($p<0.05$)

Table 4. Sensory quality attributes of dried banana pieces

Fruit treatment	Flavour	Texture	Colour	Taste
Sodium metabisulphite treated	2.92±0.90[b]	2.83±1.53[a]	3.83±0.58[b]	2.92±0.90[b]
Lemon juice treated	2.92±0.90[b]	3.00±1.72[a]	3.08±1.44[b]	2.42±1.65[b]
Control	4.08±0.67[a]	2.75±1.14[a]	1.67±0.99[a]	4.08±0.67[a]

Means in the same column with different letters as superscripts are significantly different ($p<0.05$)

protective nature of sodium metabisulphite and backing the findings of Mozumder, et al (2012) who reported that potassium metabisulphite and calcium chloride treated samples showed better colour than the other samples. The lower scores for colour in control samples could also be explained by the findings as reported by Kudra and Strumillo (1998) who stated that colour changes of materials during dehydration is not only due to evaporation of the surface water but also due to certain reactions such as enzymatic browning and caramelizations and it is assumed that the pre-treatments might have played a part in reducing these reactions resulting in better colour than in control samples. Higher scores were registered in taste for the control samples than the pre-treated samples which could be attributed to the impacted taste o the bananas by the pre-treatments resulting in lower scores.

CONCLUSIONS

From the findings of the study, it can be concluded that sodium metabisulphite and lemon juice as pre-treatments significantly reduced the degradation of vitamin C in dried pineapple, mango and banana pieces. The results have revealed that the extent of vitamin C degradation in dried fruit pieces was higher in the control samples than in pre-treated samples.

Sensory quality attributes namely flavour, colour and taste of the dried fruit pieces were significantly affected by the pre-treatments. However, texture was not significantly affected by the pre-treatments in all the three fruit types. With the exception of pineapple fruit where flavour was highly rated for pre-treated samples, for mango and banana fruits, flavour was highly rated in control samples than in pre-treated samples while for colour regardless of fruit type, pre-treated samples had higher scores than control samples.

It can therefore be concluded that the pre-treatments used significantly affected the sensory quality attributes of the dried fruit pieces in different ways and degradation of vitamin C in the dried fruit pieces was noticeably reduced through the use of sodium metabisulphite and lemon juice.

ACKNOWLEDGEMENTS

We are greatly indebted to management of Bunda College through the faculty of agriculture for providing funds for the study. Thanks to staff of Agricultural Engineering Department for providing technical assistance in the use of the developed food drier used in this study. Lastly, we are thankful to Mr. Lameck Fiwa for compiling and providing data for the operating system of the food drier.

REFERENCES

Abano EE (2010). Assessments of drying characteristics and physio-organoleptic properties of dried pineapples under different pre-treatments. Asian J. Res. 4:155-161

AOAC (2000). Official Methods of Analysis of AOAC International, 17th edition. Washington, USA

Bhardwaj JC, Kaushal BBL (1990). A study on drying behaviour of rings from different apple cultivars of Himachal Pradesh. J. Food Sci. Technol.; 27(3):144-149

Brett A, Cox DRS, Simmons R, Anstee G (1996). Producing solar dried fruits and vegetables for micro and small-scale rural enterprise development: Handbook 3: Practical Aspects of Processing. Chatham, UK

Cano MP, De Ancos B, Matallana MC, Camara M, Reglero G, Tabera J (1997). Differences among Spanish and Latin-American banana cultivars: Morphological, chemical and sensory characteristics. Food chemistry. 59(3):411-419

Dorofejeva K, Rakcejeva T, Galoburda R, Dukalska L, Kviesis J (2011). Vitamin C content in Latvian cranberries dried in convective and microwave vacuum driers. Procedia Food Science. 4:433-440

Fennema OR (1993). Quimica de los Alimentos. Zaragoza, Spain: Editorial Acribia

Gathambiri CW, Karanja CN, Kiiru SN (2005). Effect of drying on quality of mango (*Mangifera indica*) slices. Retrieved on 17th February, 2013 from www.kari.org/fileadmin/publications/10th proceedings/poster/effect_drying_qlty_mango.pdf

Gherardi S, Laratta B, Loiudice R, Trifiro A, Addario G, Zanotti A, Castaldo D (1994). Sulla tecnologia di produzione del succo di ananas: Composizione del succo e termoresistenza della pectin-metilesterasi. Industria.

Hernandez Y, Lobo MG, Gonzalez M (2013). Determination of vitamin C in tropical fruits: A comparative evaluation of methods. Retrieved on 18th February, 2013 from www.icia.es/icia/download/postcosecha/vitamin c.pdf

James IF, Kuipers B (2003). Preservation of fruits and vegetables, 4th edition. CTA publications, Wageningen, Netherlands

Karim OR (2005). Effect of pre-treatment on drying kinetics and quality attributes of air-dehydrated pineapple slices. PhD thesis, University of Agriculture, Abeokuta, Ogun state, Nigeria

Kudra T, Strumillo C (1998). Thermal processing of bio-materials. Gordon and Breach Sci Publications, Amsterdam, Netherlands

Latapi G, Barret D (2005). Influence of pre-drying treatments on quality and safety of sun-dried tomatoes. Part 1: Use of steam blanching, boiling brine blanching and dips in salt or sodium metabisulphite. J. Food Sci.; 71(1):S24-S31

Marfil PHM, Santos EM, Tellis VRN (2008). Ascorbic acid dehydration kinetics in tomatoes at different drying conditions. LWT-Food Sci. Technol.; 41(9):1642-1647

Masamba KG, Mndalira K (2013). Vitamin C stability in pineapple, guava and baobab juices under different storage conditions and using different levels of sodium benzoate and metabisulphite. Afri. J. Biotechnol.; 12(2):186-191

Mashau ME, Moyane JN, Jideani IA (2012). Assessment of post harvest losses of fruits at Tshakhuma fruit market in Limpopo province, South Africa. Afri. J. Agric. Res.; 7(29): 4145-4150

McMinn WAM, Magee TRA (1997). Physical characteristics of dehydrated potatoes. J. Food Engine.; 33:37-48

Mozumder NHMR, Rahman MA, Kamal MS, Mustafa AKM, Rahman MS (2012). Effects of pre-drying chemical treatments on quality of cabinet dried tomato powder. J. Envir. Sci. Nat. Res.; 5(1):253-265

Panagiotou NM, Karathanos VT, Maroulis ZB (1998). Mass transfer modeling of the osmotic dehydration of some fruits. International J. Food Sci. Technol.. 33 (3):267-284

Smart ED, Symonds M (1995). Commercial fruits and vegetable products. McGraw-Hill Book Co. Inc, Newyork, London.

Wills RB, McGlasson GD, Joyce D (1998). Postharvest: An introduction to the physiology and handling of fruits, vegetables and ornamentals. CAB international, Walling Ford, UK.

World Food Logistics Organisation (2010). Identification of appropriate postharvest technologies for improving market access and income for small horticultural farmers in sub-Saharan Africa and south Asia. Retrieved on 15th February, 2013 from www.ucce.ucdavis.edu/files/datastore/234-1848.pdf