Journal of Food Technology 5 (1): 1-4, 2007

Physico-Chemical Properties, Metal Contents and Organoleptic Characteristics of Juice Samples

[1]F.O. Abulude, [1]O.O. Oyeneye, [2]A.O. Elemide, [2]O.O. Okunola and [1]B.F. Alaja
[1]Department of General Studies, [2]Department of Agricultural Engineering
Federal College of Agriculture, Akure 340001, Ondo State, Nigeria

Abstract: Juice samples were extracted from tomatoes, orange and pineapple fruits by using hand squeezing method (control) and a manual juice extractor constructed at Department of Agricultural Engineering, Federal College of Agriculture, Akure, Nigeria. The samples were subjected to metal contents, physico-chemical and organoleptic tests using standard methods of analyses. From the results, it was observed that metal contents in the control (As, 10 to 20 mg $L^{-1;}$ Zn, 2.4 to 7.1 mg L^{-1} and Fe, 3.4 to 6.7 mg L^{-1}) were higher than the test (As, ND to 10 mg L^{-1}; Zn 1.2 to 2.8 mg L^{-1} and Fe, 2.5 to 3.4 mg L^{-1}), which may be due to heat reaction and contaminations from anti- rust paint and the grease used in the juice extractor. Al was not detected. The overall acceptability of the control was higher than the test. It is recommended that juice samples should be fortified with additives after extraction or during storage to replace loss nutrients and stainless steel should be used for the fabrication.

Key words: Fruit juice, extractor, hand squeezing, nutrient loss, fortification

INTRODUCTION

In Nigeria fruits have been introduced from elsewhere during the great voyages of discovery and exploration. Fruits are healthful, protective food, contain essential nutrients such as vitamin C, minerals, carotene and dietary fibre (Dignan *et al*., 1994). Their availability depends on seasonal, climatic, geographical, environmental and social and economic factors. Fruits are used for the production of juice (Malolo *et al*., 2001).

Fruit juice extraction is essential to ensure effective storage and prevent unnecessary losses and wastages. Fruit extraction has been known for quite a long time ever before the machines were invented. Extraction started with the use of hand that was slow and tedious. The use of machine and other methods came into being as the demand for juice consumption increased (Emuleomo, 2005). Machines used for extraction are imported into the country, because of cost implication this has hindered the processing of fruit juice by small scale industries. It is the therefore essential to develop indigenous equipment for the processing (Adewumi, 1998). To this end a manually operated juice extractor was designed and constructed by (Abulude *et al*., 2006). This present study is a further work to their construction. Therefore the aim of this study is to determine metal contents, physcio-chemical and organoleptic properties of the juice samples obtained from tomatoes, sweet orange and pineapple fruits obtained in Akure, Nigeria.

MATERIALS AND METHODS

Preparation of juice: Mature fruit samples (Table 1), approximately 1 kg each were purchased from a local market in Akure, Nigeria in July 2006. Samples were handpicked and transferred to our laboratory at the General studies Department, Federal College of Agriculture, Akure. The juice samples (Test) were extracted after taking the followings into consideration: cleaning to remove foreign materials, picked to separate unripe from ripe ones, washed with clean water, rinsed with distilled water, sliced into pieces with knife, crushed and pressed in a constructed juice extractor. Design and construction had been explained in the literature (Abulude *et al*., 2006). The pressed juice samples were filtered through muslin white cloth and later stored at ambient conditions in plastic containers for 3 h prior to analyses. The control samples were obtained following the procedures for the test samples except that extraction was carried out using hand squeezing of fruits (Fig. 1).

Table 1: Botanical, common and local names of fruits used for the analysis

Botanical name	Common name	Local name
Citrus sinensis	Sweet orange	Osan
Lycopersicon esculentum	Tomatoes	Tomati
Ananas sativus	Pineapple	Ope Oyinbo

Correponding Author: F.O. Abulude, Department of General Studies, Federal College of Agriculture, Akure 340001, Ondo State, Nigeria

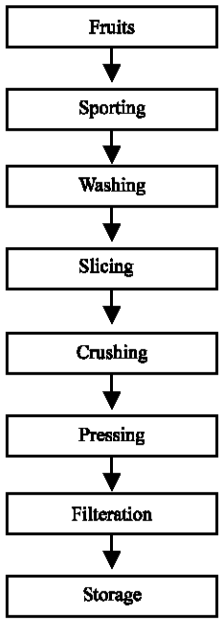

Fig 1: Flow diagram for preparation of fruit juice samples

Physico-chemical analysis: The pH of samples was obtained using a digital pH meter (Kent EIL, Kent Ltd, UK). The acidity was determined by titrating samples with 0.1M Na0H and was expressed as percentage citric acid (Pearson, 1976).

Mineral analysis: Minerals were extracted by the wet ashing methods. The sample was measured ($1 cm^3$) into a beaker, $10 cm^3$ of 1% HCL was added and heated on a hot plate until the content was reduced to about $1 cm^3$. This content was made up to $50 cm^3$ with 1% HCL. The solution were stored in plastic containers and labeled (OTM-Tomato extracted with hand, OPA-Pineapple extractor with hand, OOR-Orange extracted with hand, TOR-Tomatoes extracted with extractor, TPA-Pineapple extracted with extractor and TTM-Orange extracted with extractor) until analyzed for Pb, Al, Zn, As and Fe using flame atomic absorption spectrophotometer (Pye Unicam, Cambridge, UK).

Sensory evaluation: To evaluate the samples' acceptability, color, taste and flavor. A 9-point scale was used by trained panel of 10 judges in Chemistry laboratory of Federal College of Agriculture, Akure Nigeria. The quality parameters were quantified and the mean scores of ten evaluations were calculated. Data obtained from all the analyses were statistically evaluated by using SPSS 10.0 for windows.

RESULTS AND DISCUSSION

Table 2 shows the Pb, Al, As, Fe, Zn, pH and titratable acidity of the control and test samples. The As content (10-20 mg L^{-1}), Fe (3.4-6.7 mg L^{-1}) and Zn (2.4-7.1 mg L^{-1}) in the control juice samples were higher than the test juice samples (As (ND-10 mg L^{-1}) Fe (2.5-3.4 mg L^{-1}) and Zn (1.2-2.8 mg L^{-1}) this could be due to the mechanical extraction involved in the production of juice as a result of change due to destruction during production with the constructed juice extractor and substantial elemental reserves remaining in the residue (skin and pulp) after the juice was expressed. Al was not detected in all the juice samples. Pb produced values of between ND-1.7 mg L^{-1}. It is gratifying that the presence of this element would cause no problem since the values obtained was below the toxic level. Pb has been reported

Table 2: Metal content (mg L^{-1}) and physcio-chemical parameter of the fruit juice samples

Codes[a]	Pb	Al	As	Fe	Zn	pH	Titratable acidity (%)
OTM	ND	ND	20.0	6.7	2.4	3.4	1.2
TTM	ND	ND	ND	3.4	1.2	3.6	1.5
OOR	0.8	ND	10.0	4.5	7.2	3.7	0.9
TOR	0.8	ND	10.0	3.4	2.8	4.0	0.9
OPA	1.7	ND	20.0	3.4	2.4	4.0	0.8
TPA	1.7	ND	ND	2.5	1.2	3.5	0.9
Mean	1.3	0.0	15.0	4.0	2.9	3.7	1.0
±Sd[b]	0.6	0.0	5.8	1.5	2.2	0.3	0.3
CV(%)[c]	41.6	0.0	38.5	37.0	78.7	6.8	25.7

[a]OTM-Tomato extracted with hand, OPA-pineapple extracted with hand, OOR –Orange extracted with hand, TOR-Tomatoes extracted with extractor, TPA-Pineapple extracted with extractor, TTM-Orange extracted with extractor. [b]±SD-standard deviation, CV(%)- coefficient of variation in percent, ND-Not detected

Table 3: Comparison of some of our results with literatures

Samples	Fe (mg L^{-1})	Zn (mg L^{-1})	pH	Titratable acidity (%)	Country	Reference
Grape fragments	1.40-3.00	0.20-11.40	3.69-4.10	0.38-0.99	Saudi Arabia	Ewaidah, 1993
Apricot puree	-	-	3.00-4.20	0.57-2.75	Italy	Voi *et al.*, 1995
Apple juice	0.10-4.40	0.01-0.40	3.30-3.80	0.22-0.60	USA	Elkins *et al.*, 1996
Mango wine	-	-	4.00-6.00	0.30-0.44	Nigeria	Ojukwu *et al.*, 2000
Fruit added yogurts	1.10-2.00	2.00-11.6	4.06-4.44	0.95-1.14	Turkey	Ayar *et al.*, 2006
Kunuzaki beverage	5.60-9.20	2.90-4.10	3.50-4.22	-	Nigeria	Abulude *et al.*, 2006
Sapota juice and powder	-	-	-	0.24-0.38	India	Ganjyal *et al.*, 2005
Tomatoes, pineapple Orange juice	2.50-6.70	1.20-7.10	3.40-4.00	0.08-150	Nigeria	Present study

to be extremely dangerous to human health, it gives rise to a quite number of clinical syndrome like brain damage, behavioral disorders and impaired hearing (Asaolu, 2002). Zn supports the health of the immune system, normal synthesis of protein and the health of reproductive organs (especially in men). The deficiency of Zn adversely affects normal physical growth, skin, nerve health, natively healing ability and immune function especially in infant (Anhwange *et al*., 2005). Fe is one of the most important elements in nutrition and good health, the total amount in human body is 4-5 g. The RDA is 10-15 mg day^{-1}. Pregnancy, lactation and rapid growth increase iron requirement. Iron deficiency is known as anemia. Anemia is diagnosed when hemoglobin levels in the body fall below 13 g dL^{-1} for men and below 12 g dL^{-1} for women. Iron deficiency symptoms include fatigue, depressed growth, decreased resistance to infection tiredness and depressed mouth sores (Nieman *et al*., 1992). Al is the third most abundant element in the earth's crust, and the human body contains 50-150 mg. Excessive exposures to Al causes Alzheimer's disease, a form of senility in elderly patients. Less than 150 mg day^{-1} does not appear to impair the body's ability to absorb Ca, Mg, Zn, Fe or Cu (Nieman *et al*., 1992). A level of 0.003 mg kg^{-1} bw/d was determined to be the tolerance epidemiological data. Generally most foods contain low levels of arsenic. Seafood contains up to 10 times the arsenic of other foods (FASNZ, 1993).

A comparison between our results and other authors are shown in Table 4. In this study, the obtained Fe content of the samples ranged between 2.5-3.4 mg L^{-1} (test) and 3.4-6.7 mg L^{-1} (control). These values were in agreement with values reported by Ewaidah (1993) for grape apple juice (Elkins *et al*., 1996) and fruit added yogurts (Ayar *et al*., 2006), but our values were lower then the results recoded for kunuzaki beverage (Abulude *et al*., 2006), consistent findings to our study with respect to pH were found by Ewaidah (1993) and Voi *et al*. (1995) for grape and apricot puree respectively. In USA, Elkins *et al*. (1996) reported the findings with regard to pH in apple juice similar to our results, but the maximum pH of 6.50 was higher compared to this study. Ojukwu *et al*. (2000) observed moderately consistent results to our study with respect to wine made from mango. Lower values were reported by Abulude *et al*. (2006) for kunuzaki beverage. The pH values for the samples are shown in Table 2. Every microorganism has a minimal, and an optimal pH required for its growth. The excellent keeping qualities of fruits are related to their respective pH, food with low pH values (below 4.5) usually are not really spoiled by bacteria but are more susceptible to spoilage by yeasts and moulds (Adeyeye and agersin, 1999).

Table 4: Organoleptic evaluation of fruit juice samples

Codes[a]	Color	Odor	Taste	Overall acceptability
OTM	6.0	6.0	6.0	6.0
TTM	6.0	6.0	6.0	6.0
OOR	8.0	8.0	7.0	7.0
TOR	6.0	6.0	6.0	6.0
OPA	8.0	8.0	8.0	8.0
TRA	6.0	7.0	6.0	6.0
Mean	6.7	6.8	6.5	6.5
±Sd[b]	0.9	0.9	3.3	3.3
V(%)[c]	13.4	13.2	50.8	50.8

a,b,c-see footnote Table 2

The results of organoleptic evaluation are shown in Table 4. Sample OOR and OPA had the highest value of 8.0 for color and flavor. The panelists rated the control samples high. There was least preference for test samples in terms of color, flavor and taste. This could be due to the anti-rust paint and grease used for lubrication of jointed parts of the fabricated extractor.

CONCLUSION

This study evaluated the minerals, physico-chemical contents and organoleptic properties of juice samples produced through hand squeezing (control) and a constructed juice extractor (Test). From the results it was observed that the metal contents decreased in the test samples. General acceptability of the control was higher than the test samples. It is recommended eliminating the use of anti-rust paint and grease should modify that constructed juice extractor. Also adequate fortification should be employed after machine extraction and during processing, to replace nutrient loss and to improve organoleptic properties.

REFERENCES

Abulude, F.O., A.O. Elemide, M.O. Ogunkoya and W.O. Adesanya, 2006. Design and performance evaluation of a juice extractor constructed in Nigeria. Res .J. Appl ied Sci.

Abulude, F.O., M.O. Ogunkoya and V.A. Oni, 2006. Metal composition, shelf life and sensory attributes of fortified 'kunuzaki' beverage. Acta Sci. Pol. Tech. Aliment., 5: 155-162.

Adewumi, B.A., 1998. Developing indigenous machinery base for cup and food processing industry in Nigeria. Proceeding of the Agricultural Engineers' Conference. Annual General meeting of Nigeria Society of Engineers, Maiduguri, Nigeria, pp: 43-48.

Adeyeye, E.I. and Agesin, 1999. Nutritional composition of *Chrysophyllum albidum, Malus pumila* and *Psidium guajava* fruits. Bangladesh J. Sci. Ind. Res., 34: 452-458.

Anhwange, B.A., V.O. Ajibola and S.J. Oniye, 2005. Composition of bulk, trace and some rare elements in the seeds of *Moringa oleifera* (Lan), *Deuterium microcarpum (Guilland perr)* and *Bauhinia monadra (kurz).* J. Food Tech., 3: 290-293.

Asaolu, S.S., 2002. Determination of some heavy metals in *Orechromis niloticus, Clarias gariepinus* and *Synodontis sp.* from the coastal water of Ondo state Nigeria. Pak. J. Sci. Ind. Res., 45: 17-19.

Ayar, A., D. Sert, H. Kalyoncu and F. Yazici, 2006. Physical, chemical, nutritional and organoleptic characteristics of fruit added yogurts. J. Food Tech., 4: 44-49.

Dignan, C.A., B.A. Burlingame, J.M. Arthur, R.J. Quigley and G.C. Milligan, 1994. The Pacific Island food composition tables. South Pacific Commission, Noumea, New Caledonia.

Elkins, E.R., A. Matthys, R. Lyon and C.J. Huang, 1996. Characterization of commercially produced apple juice concentrate. J. Food Comp. Analyt., 9: 43-56.

Emuleomo, M.A., 2005. Construction and evaluation of juice extractor. National Diploma Thesis. Depart. Agric. Eng. Federal College of Agriculture, Akure, Nigeria. Unpublished.

Ewaidah, E.H., 1993. Nutritive composition of Al-Nokel grape fragments and the potentiality of making evaporator-concentrate. Food Chem., 46: 243-252.

FASNZ, 2002. Metals and other substances-selenium. 20th Australian Total Diet Survey Part B., pp: 1-12.

Malolo, M., T.M. South and J. Tunidau-Schultz, 2001. The fruits we eat. Handbook of New Caledonia Secretariat of the Pacific Community, pp: 16-21.

Nieman, D.C., D.E. Butterworth and C.V. Nieman, 1992. Nutrition. Revised 1st Edn., Wm. C. Brown Publishers, USA, pp: 294-305.

Ojukwu, U.P., I.B. Enujiugba and E.N. Ezejiofor, 2000. Production of wine from wild mango (*Irvingia gabonensis*) pulp. Nig. J. Tech. Educ., 17: 51-55.

Pearson, D., 1976. Chemical analysis of foods. 7th Edn., Churchill Livingstone, London.

Voi, A.L., M. Impembo, G. Fasanro and D. Castaldo, 1995. Chemical characterization of apricot puree. J. Food Comp. Analyt., 8: 78-55.