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Full Length Research Paper

Comparative studies on mixed fruit jam packaged in different local containers

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ABSTRACT

As Nigeria is a producer of abundant fresh fruits but has effective preservation and packaging challenge, this work aims to compare some quality factors of mixed fruit Jam that was packaged in different locally available containers for a 15-month storage period at room temperature. Virtual inspection, pH, moisture content, total soluble solids and microbiological assessment of the samples were conducted to determine their keeping quality. Sensory evaluation was also conducted to determine the acceptability of the packaged samples. The result showed that after the 15-month storage at room temperature, gel consistency of the samples were maintained in the plastic plates and glass jar packages, while the samples in sachet water pouch and polythene packages became runny. The pH of the samples was between 3.4-3.5. The moisture content was between 28-37% while the total soluble solids was between 63-72%. The total microbial counts of all the samples after 15-months storage were within the acceptable range of 1 x 10^3cfu/ml. There was no fungal growth in all the packaged samples except in the transparent plastic plate that exhibit a growth of 6 x 10^2. There was no bacterial and coliform growth in all the packaged samples. The result of the sensory evaluation shows that glass jar and white plastic plate with screw cover container were significantly (p=0.05) more acceptable for packaging Jam spread than those in the other containers used. Hence, it was concluded that some locally available packages can be used for packing shelf-stable small scale Jam production for in a developing nation.

Keywords: Fruit preserves, Jam, Packages, Gel consistency, shelf-life, pH, TSS.

INTRODUCTION

Nigeria is an agriculturally active nation that is blessed with abundant fertile land for food production. During the rainy season, large quantities of various fruits are harvested mainly for retail consumption. A considerable amount of such fruits get spoilt before they are sold, while others are lost at the end users table due to the highly perishable nature of the commodity. Consequently, one method of economically reducing post-harvest losses of fruits is by preserving it in high-sugar syrup, known as fruit preserves. Jam, jelly and marmalade are the common fruit preserve that can easily be produced at the small and medium scale for wealth creation in a developing economy.

However, there has been a challenge of packaging of locally manufactured preserves for commercialization, as the usual packages for such products are imported glass jars that are not readily available and affordable to an average local producer. This led to the exploration of other options that are more economical, such as plastic tubs that have lower production and distribution costs in Uganda (United Nations Industrial Development Organization, UNIDO, 2004). Re-used containers are also collected, but great care is needed to ensure that they are properly cleaned and sterilized. Also used are pots that are sealed with a foil lid or with a snap-on plastic lid, and plastic film.

ABBREVIATION

WJ white plastic plate with screw cover
TJ transparent plastic plate with pull-press cover
SJ sachet water package
PJ polythene pouch
GJ glass jar
TSS total soluble solids
GSO Gulf Standard Organization

Figure 1. The different locally available containers used in the study. From left to right: WJ (white plastic plate with screw cover), SJ (sachet water package), TJ (transparent plastic plate with pull-press cover) , PJ (polythene pouch).

In Nigeria, these various packaging materials have not been utilized for local production of preserves for commercialization. A cursory survey of some retail markets revealed mainly the imported ones in glass jars. Thus, this work attempted to compare some quality parameters of mixed fruit Jam packed in different common packages in Nigeria, after a long storage period of 15 months.

METHODOLOGY

The different packaging containers used were obtained from a local market in Abuja. They were labeled as WJ (white plastic plate with screw cover), TJ (transparent plastic plate with pull-press cover), SJ (sachet water package), PJ (polythene pouch), as shown in figure 1; and GJ (glass jar).

Sample preparation

Watermelon and orange fruits were obtained from a local market in Abuja and pre-processed to remove the seeds, pit and rinds. Mixed-fruit Jam was then prepared according to the method of Fellows and Hampton (1992) as outlined in figure 2. Thereafter, the jam was filled into five (5) different packages made of plastic and polythene materials, and a fifth package of glass jar.

Shelf life study

The packaged samples were kept at room temperature and monitored every month for the first sign of deterioration, which is, liquid formation on the surface (Consumer Voice, 2015). After 15 months of storage, the samples were taken for comparative physical characteristics of pH, moisture content and total soluble solids (TSS); and microbiological enumeration of total bacterial, total fungal and total coliform counts. The pH was measure with a pH meter while the moisture content and the TSS were determined by the oven-drying method. Total bacterial count was made after 24 hours of incubation at 37º ± 2ºC on Nutrient agar, yeast and mould (fungal) count was made after 72 hours incubation at 28º ± 2ºC on Potato Dextrose Agar (Akinyele and Oloruntoba, 2013), while the coliform count was made after 24 hours of incubation at 37º ± 2ºC on MacConkey agar.

Sensory evaluation

The samples were subjected to organoleptic assessment by 10 panelists that are familiar with the product. The parameters assessed were consistency, appearance (colour), spreadability and overall acceptability. A 7-point hedonic scale was used to measure the respondents evaluations, from 1 (Disliked extremely) to 7 (Liked extremely).

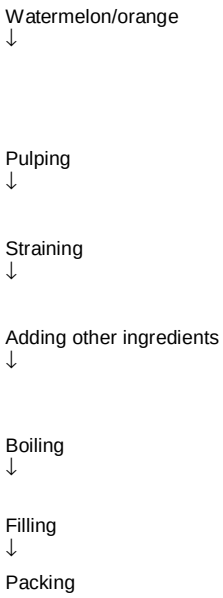

Figure 2. The flow chart for mixed Jam production. The figure shows the different stages involved in the production of Jam from combination of watermelon and orange fruits.

Table 1. Physical and Microbial Characteristics of packaged Jam samples after 15 months storage.

Samples	pH	Moisture content(%)	TSS (%)	Total bacterial count (cfu/ml)	Total Fungal count (cfu/ml)	Coliform count (cfu/ml)
SJ	3.4	28	72	0	0	0
PJ	3.4	34	66	0	0	0
GJ	3.4	37	63	0	0	0
WJ	3.5	36	64	0	0	0
TJ	3.5	33	67	0	6×10^{-2}	0

The table shows that pH of the samples was between 3.4-3.5. The moisture content was between 28-37% while the total soluble solid was between 63-72%. The total microbial counts of all the samples after 15-months storage were within the acceptable range of 1×10^{3}cfu/ml.
Key: WJ (white plastic plate with screw cover), TJ (transparent plastic plate with pull-press cover), SJ (sachet water package), PJ (polythene pouch) and GJ (glass jar).

RESULT

The virtual observation of the samples showed that there was loss of firmness in both samples packaged in sachet water and polythene pouch, while the other packages maintain their firmness. There was no appreciable darkening of the colour in each of the samples.

Table 1 shows the result of the physical parameters of pH, moisture content, total soluble solids (TSS), and the microbiological enumeration of the different packaged samples after 15 months storage at room temperature. In table 2, the mean scores of the sensory evaluation by ten (10) judges are presented.

DISCUSSION

As expected from the low pH values (3.4-3.5) of the samples and the high total soluble solids range (63-72%), the samples' environmental conditions made it impossible for the proliferation of microorganisms. This was evident from the absence of bacteria, coliform and fungi in the packaged samples except for the transparent plastic plate, which exhibited a fungal growth of 6×10^{2}cfu/ml. This result agreed with Dauthy (1995) that all micro-organisms are destroyed within the product during jam boiling, and if it is filled hot into clean receptacles which are subsequently sealed, and then inverted so that the hot jam contacts the lid surface,spoilage by micro-organisms will not take place during storage.

Also, the total absence of coliform group in all the samples confirms the good sanitary condition of the Jam preparation process. Cornell University Department of Food Science (2007) indicated that one of the most common applications of coliform bacteria as indicator organisms is in their association with hygienic conditions and overall quality, especially concerning heat processed

Table 2. The Mean Scores of Sensory Evaluation Result.

Samples	Appearance	Consistency	Spreadability	Overall acceptability
GJ	5.70±0.37[b]	4.40±0.45[c]	3.90±0.38[f]	6.00±0.39[j]
PJ	3.20±0.25[a]	5.50±0.45[e]	6.20±0.25[h]	4.40±0.37[i]
SJ	3.20±0.53[a]	5.00±0.56[d]	6.10±0.28[h]	4.90±0.35[i]
WJ	5.70±0.38[b]	4.90±0.31[d]	5.10±0.18[g]	6.00±0.33[j]
TJ	2.90±0.28[a]	5.10±0.41[d]	5.20±0.39[g]	4.80±0.25[i]

The table shows that glass jar and white plastic plate with screw cover container were significantly (p=0.05) more acceptable for packaging Jam spread than those in the other containers used.
**Figures with the same letters along a column are not significantly different (p=0.05). Key: WJ (white plastic plate with screw cover), TJ (transparent plastic plate with pull-press cover), SJ (sachet water package), PJ (polythene pouch) and GJ (glass jar).*

foods, as they are killed by most heat processing conditions; therefore their presence in a food generally indicates an inadequate heat process or post-processing contamination.

Similarly, the fungal growth of 6 x 10^2cfu/ml encountered in the transparent plastic plate was within the acceptable limit of 1 x 10^3cfu/ml (Gulf Standard Organization, GSO, 2014).

The result of the sensory evaluation shows that the Jam packaged in the glass jar and white plastic plate with screw cover significantly retained their colour (appearance) better than the other packages used. In terms of consistency, the packaged Jam in polythene pouch was most preferred, closely followed by those in white plastic plate with screw cover, transparent plastic plate with pull-press cover and sachet water packages. Similarly, the most preferred for spreadability on bread are those packaged in sachet water package and polythene pouch, followed by white plastic plate with screw cover and transparent plastic plate with pull-press cover. Lastly, glass jar and white plastic plate with screw cover packages were significantly (p=0.05) more acceptable for packaging Jam spread than those in the other packages used.

CONCLUSION

The comparative study showed that the use of some locally available containers for the aseptic packaging of Jam spread can adequately preserve it for a considerable period of storage at room temperature. Hence, it was concluded that some locally available containers can be used for packing small scale Jam production for commercialization.

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