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The Effect of Chemical Preservatives, Pasteurization and Refrigeration on the Shelf Life of Agadagidi A Fermented Plantain Drink

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ABSTRACT

Local alcoholic beverages produced in Africa involve the activities of an array of microorganisms to produce drinks of acceptable quality characteristics through fermentation, this study aimed to evaluate the potentials of pasteurization, refrigeration and two chemical preservatives; sodium benzoate and sodium metabisulphite for the preservation of 'agadagidi' a locally fermented plantain drink. Freshly prepared agadagidi samples were preserved using these three treatments for an eight week storage period. Locally purchased and laboratory prepared samples without any treatment served as control. Samples were stored at room temperature (28±2°C) except those preserved by refrigeration. Some treatments were combined to observe their synergistic effect. Physicochemical parameters and microbiological changes were monitored throughout the storage period. Results obtained indicated three bacteria (*Leuconostoc mesenteroides*, *Micrococcus varians* and *Bacillus subtilis*) and four fungi (*Saccharomyces cerevisiae*, *Saccharomyces chevalieri*, *Schizosaccharomyces pombe* and *Candida albicans)* were isolated from the agadagidi samples. Microbial counts increased throughout storage with the treated samples recording lower counts (6.0 and 1.97×10^6 CFU mL^{-1}) than control (19.0 and 2.04×10^6 CFU mL^{-1}) for bacteria and fungi, respectively. Physicochemical changes during storage showed increase in titratable acidity, decreases in pH, total sugars and alcohol contents of treated samples. Samples treated with sodium benzoate and refrigeration were shelf stable up to 6 weeks, pasteurized samples stored at ambient temperatures were shelf stable for 4 weeks. Sensory evaluation tests indicated agadagidi treated with chemical preservatives and refrigeration with or without prior pasteurization were acceptable to consumers up to 8th week of storage. This study revealed a new possibility for the improvement of the shelf life of agadagidi from the usual 2-3 days to 8 weeks with combined processes of pasteurization, refrigeration and the addition of chemical preservatives.

Key words: Agadagidi, preservation, alcoholic beverages, shelf life, chemical preservatives

INTRODUCTION

Indigenous African beverages are derived from the acknowledged role of alcohol in the cultural activities of all population groups and the need for maximum utilization of excess harvests which may otherwise not be preservable. This purpose can be achieved through fermentation. Fermentation is used in the production of drinks and food. The consequence of most fermentation

is generally to increase the quality of such drinks or foods. African fermented alcoholic beverages differ from most European beers and wines in that they contain a mixture of acids and alcohol. They contain in most cases over 90% water and have a sour taste due to the involvement of lactic acid and acetic acid bacteria. However, they are still nutritious as they contain vitamins and other essential growth factors. Yeasts play a prominent role in the fermentation of many African fermented beverages (Ekunsanmi and Odunfa, 1990; Sanni, 1993; Sanni *et al*., 1999). However, the main drawback of these beverages is their relatively short shelf life usually between 2-3 days.

There are a number of indigenous alcoholic beverages in Africa. They include pito, agadagidi, sekete in Nigeria, bonza and kish in Egypt, Burukutu in Nigeria, Ghana and Cameroun, Talla in Ethiopia. Palm wine in various parts of West Africa (Ekunsanmi and Odunfa, 1990). There is widespread use and production of these indigenous alcoholic beverages in the local communities. Agadagidi is an alcoholic beverage made from overripe plantain pulp. Plantain (*Musa acuminata* synonym: *M. paradisiaca* L.) is a tropical plant grown in home gardens for domestic consumption and also in large plantations for the local market and export. It grows on a wide range of soils provided there is good drainage, adequate fertility and moisture. This plant matures during the rainy season and fruits in the dry season. However, it can be available all the year round. The fruit is green while the ripe fruit is yellow in colour. Agadagidi is popular among the Yoruba speaking areas in South West Nigeria. The fermentation of overripe plantain to produce agadagidi is a waste prevention processing of plantain, a perishable crop which has much less value when it is overripe, hence its use for wine production (Sanni and Oso, 1988a; Akinyanju and Oyedeji, 1993; Sanni *et al*., 1999). Many indigenous fermented food and beverages are faced with various challenges among which are short shelf life and microbial-induced spoilage within few days of production. These developments can be attributed to uncontrolled fermentation and the crude methods used for the production of such food and beverages.

The objective of this study was to evaluate the effect of some preservation treatments mainly pasteurization, refrigeration and the use of two chemical preservatives sodium benzoate and sodium metabisulphite on the keeping quality of agadagidi.

MATERIALS AND METHODS

Preparation of agadagidi samples: This study commenced in December 2010 and terminated in February 2011. Ripe plantains were purchased from the local market and kept for 4-5 days until they became overripe and soft. The plantain fruits were washed under running water to remove dirt, peeled and cut into small pieces. These were then soaked in water in ratio 1:5 w/v in clean plastic containers and covered and left to ferment for 3 days at room temperature. At the expiration of fermentation, the agadagidi was then filtered through two layers of muslin cloth to remove the plantain pulp. The fermented drink was then dispensed into sterile containers for treatment. Locally purchased agadagidi and laboratory prepared samples without treatment served as control.

Treatment of agadagidi samples: Sodium benzoate (0.1% concentration), sodium metabisulphite (0.025%), refrigeration (5°C) and pasteurization (63°C for 30 min) were used for the preservation of the agadagidi as follows:

- Agadagidi samples purchased commercially and without any preservatives, stored at room temperature (26°C+1). These served as the control 1
- Agadagidi samples prepared in the laboratory using sterile water for preparation and aseptic techniques without any preservatives, stored at room temperature (26°C+1). These served as the control 2
- Agadagidi samples stored at 4°C: Fridge
- Agadagidi samples pasteurized and stored at 4°C: P fridge
- Agadagidi samples pasteurized and stored at 26±1°C: P room
- Agadagidi samples treated with 0.1% sodium benzoate and stored at 4°C: B fridge
- Agadagidi samples treated with 0.1% sodium benzoate and stored at 26±1°C: B room
- Agadagidi samples treated with 0.025% sodium metabisulphite stored at 26°C±1: M room
- Agadagidi samples treated with 0.025% sodium metabisulphite stored at 4°C: M fridge
- Agadagidi samples pasteurized, treated with 0.1% sodium benzoate, stored at 26°C±1: PB room
- Agadagidi samples pasteurized, treated with 0.025% sodium metabisulphite, stored at 26°C±1: PM room
- Agadagidi samples pasteurized, treated with 0.025% sodium metabisulphite, stored at 4°C: PM fridge
- Agadagidi samples pasteurized, treated with 0.1% sodium benzoate, stored at 4°C: PB fridge
- Agadagidi samples pasteurized and treated with 0.1% sodium benzoate and 0.025% sodium metabisulphite, stored at 26°C±1: PBM room
- Agadagidi samples pasteurized and treated with 0.01% sodium benzoate and 0.025% sodium metabisulphite, stored at 4°C: PBM fridge
- Agadagidi samples treated with 0.01% sodium benzoate and 0.025% sodium metabisulphite and stored at 4°C: BM fridge
- Agadagidi samples treated with 0.01% sodium benzoate and 0.025% sodium metabisulphite and stored at 26°C±1°C: BM room

Physicochemical analysis: The physicochemical analysis of the samples was carried on the onset of storage and monitored weekly throughout the eight week storage period. The pH of the samples was determined using a pH meter (Philips PW9418); titratable acidity was determined using the method of Egan *et al.* (1981) the alcohol content was determined using an alcohol meter; total sugars were determined using a digital refractometer (TDR 095) using the method of AOAC (1990); Mineral content analysis was determined using the method of AOAC (1980). The statistical analysis of the data was done using the Statistical Packages for Social Science (SPSS, 2004).

Microbiological analysis: Total Viable Counts (TVC), fungal counts and microbial isolation were done using standard pour plate and streak plate techniques. Serially diluted agadagidi samples were inoculated into nutrient agar and potato dextrose agar plates for estimation of bacterial and fungal numbers, respectively. Identification of isolated bacteria was done with the aid of the Bergey's Manual (Holt, 1994) using colonial and cellular morphologies and also various biochemical tests. Fungal identification was carried out using mycological atlas (Alexopolus and Mims, 1979; Beech *et al.*, 1986; Kavanagh, 2005).

Organoleptic analysis: The overall quality acceptability of agadagidi was evaluated by 5-member panel familiar with sensory evaluation techniques and regular consumers of agadagidi

evaluated sensory quality changes of samples upon storage using a 5-point hedonic scale (where 5 = very good, 4 = good, 3 = fair, 2 = poor, 1 = very poor) as described by Larmond (1977).

RESULTS AND DISCUSSION

Seven different organisms were identified in the agadagidi samples comprising three bacteria; *Leuconostoc mesenteroides*, *Micrococcus varians*, *Bacillus subtilis* and four yeasts; *Saccharomyces cerevisiae*, *S. chevalieri*, *Schizosaccharomyces pombe* and *Candida albicans*. All the microorganisms were present in control 1 and all the samples stored at room temperature except PM room (Table 1). Organisms reported in similar traditional beverages include *Kleockera apiculata*, *Torulopsis delbrueckii*, *S. cerevisiae*, *Acetobacter aceti*, *A. aerogenes*, *A. pasteurianus*, *M. luteus*, *Alcaligenes*, *Flavobacterium*, *Lactobacillus plantarum*, *L. brevis*, *L. oenos*, *Chromobacterium violaceum* and *S. lactis* (Sanni and Oso, 1988a; Sanni *et al*., 1999; Omoya and Akharaiyi, 2008). The presence of these organisms in the agadagidi samples is attributed to the environment and the fruit itself as no formal starter culture was used in the production of the wine (Table 1). The yeasts present are thought to be responsible for the alcoholic fermentation and some of these are naturally associated with ripened fruits (Sanni and Oso, 1988b; Sanni *et al*., 1999;

Table 1: Distribution of isolated microorganisms in stored agadagidi samples

	Isolated Microorganisms						
Agadagidi samples	*Saccharomyces cerevisiae*	*S. chevalieri*	*Schizosaccharomyces pombe*	*Leuconostoc mesenteroides*	*Micrococcus varians*	*Bacillus subtilis*	*Candida albicans*
Control 1	+	+	+	+	+	+	+
Control 2	+	+	+	-	-	+	-
P room	+	+	+	+	+	+	+
M room	+	+	+	+	+	+	+
B room	+	+	+	+	+	+	+
PB room	+	+	+	+	+	+	+
PM room	+	+	+	+	+	-	-
B fridge	+	+	+	-	-	+	-
PB fridge	+	+	+	-	-	+	+
M fridge	+	+	+	-	-	-	+
PM fridge	+	+	+	-	-	-	+
P fridge	+	+	+	-	-	-	+
Fridge	+	+	+	-	+	-	+
PBM fridge	+	+	+	-	-	+	+
PBM room	+	+	+	+	+	+	+
BM fridge	+	+	+	-	-	+	+
BM room	+	+	+	+	+	+	+

+: Present, -: Absent, Control 1: Sample without any preservative at room temperature, Control 2: Laboratory prepared sample without any preservative at room temperature, P room: Pasteurized sample at room temp, M room: Sodium metabisuphite at room temp, B room: Sodium benzoate at room temp, PB room: Pasteurization+sodium benzoate at room temp, PM room: Pasteurization+sodium metabisulphite at room temp, B fridge: Sodium benzoate+5°C, Fridge: 5°C, PB fridge: Sodium benzoate+pasteurization+5°C, M fridge: Sodium metabisulphite+5°C, PM fridge: Pasteurization+sodium metabisulphite+5°C, P fridge: Pasteurization+5°C, Fridge: Samples stored at 5°C, PBM fridge: Pasteurization+sodium benzoate= sodium metabisulphite+4°C, PBM room: Pasteurization+sodium benzoate+ sodium metabisulphite+room temperature, BM fridge: Sodium benzoate+sodium metabisulphite+4°C, BM room: Sodium benzoate+ sodium metabisulphite+room temperature

Jay *et al*., 2005). Some of the other isolated organisms are likely assisting in the fermentation process but not the main fermenting organisms thus serve as contaminants whose presence bring about the rapid deterioration of the agadagidi thereby reducing its shelf life. The main organism useful for the fermentation of the plantain to agadagidi is *Saccharomyces cerevisiae*. It ferments the fermentable sugars to alcohol (Akinyanju and Oyedeji, 1993; Omoya and Akharaiyi, 2008).

Series of changes in microbiology and physicochemical analyses of the agadagidi samples during storage were observed and all these changes can be attributed to the growth and activities of the microorganisms present in the agadagidi samples. The sharp decreases in the sugar, minerals and alcohol contents from their pre-storage levels (Table 2, 3) are an indication of microbial utilization. All the preserved agadagidi samples were found to have a reduction in the bacterial and fungal counts on the first day of preservation after which there was subsequent increase in the

Table 2: Physicochemical analysis and microbial counts agadagidi before storage

Samples	Total bacterial counts ($\times 10^6$ CFU mL^{-1})	Total fungal counts ($\times 10^6$ CFU mL^{-1})	pH	Titratable acidity (cm^3 mL^{-1})	Sugar content (%)	Alcohol content (%, v/v)
Agadagidi$_1$	0.88	1.28	6.58	0.058	5.97	3.0
Agadagidi$_2$	0.53	1.15	6.62	0.054	5.95	4.0

The samples represented with subscripts $_1$ and $_2$ are fresh commercial samples and laboratory-prepared samples, respectively

Table 3: Changes in the mineral content of the agadagidi samples during storage

	Pre-storage (ppm)					Post storage (ppm)				
Samples	Ca^+	Mg^+	K^+	P^+	Na^+	Ca^+	Mg^+	K^+	P^+	Na^+
Control 1	9	12	0.184	1.87	0.045	2.0	5.5	0.092	0.211	0.004
Control 2	9	12	0.184	1.87	0.045	2.0	5.0	0.092	0.252	0.004
M room	9	12	0.184	1.87	0.045	5.0	4.0	0.123	0.371	0.026
P room	9	12	0.184	1.87	0.045	2.5	5.0	0.133	0.202	0.009
B room	9	12	0.184	1.87	0.045	2.5	5.5	0.133	0.306	0.004
PB room	9	12	0.184	1.87	0.045	2.0	7.0	0.051	1.437	0.004
B fridge	9	12	0.184	1.87	0.045	2.0	4.0	0.046	1.438	0.004
PB fridge	9	12	0.184	1.87	0.045	2.0	4.5	0.046	1.431	0.004
PM room	9	12	0.184	1.87	0.045	7.0	3.0	0.104	1.631	0.004
P fridge	9	12	0.184	1.87	0.045	5.0	3.5	0.082	0.258	0.004
M fridge	9	12	0.184	1.87	0.045	4.0	4.5	0.128	1.341	0.010
PM fridge	9	12	0.184	1.87	0.045	5.0	4.0	0.164	1.469	0.014
Fridge	9	12	0.184	1.87	0.045	2.0	6.0	0.092	0.214	0.009
PBM fridge	9	12	0.184	1.87	0.045	2.0	5.0	0.051	1.472	0.009
PBM room	9	12	0.184	1.87	0.045	3.0	7.0	0.123	0.982	0.007
BM fridge	9	12	0.184	1.87	0.045	3.0	7.0	0.123	0.856	0.039
BM room	9	12	0.184	1.87	0.045	5.0	4.5	0.092	1.259	0.035

Control 1: Sample without any preservative at room temperature, Control 2: Laboratory prepared sample without any preservative at room temperature, B fridge: Sodium benzoate+5°C, Fridge: 5°C, PB fridge: Sodium benzoate+pasteurization+5°C, M fridge: Sodium metabisulphite+5°C, PM fridge: Pasteurization+sodium metabisulphite+5°C, P fridge: Pasteurization+5°C, Fridge: Samples stored at 5°C, PBM fridge: Pasteurization+sodium benzoate: Sodium metabisulphite+4°C, PBM room: Pasteurization+sodium benzoate+sodium metabisulphite+room temperature, BM fridge: Sodium benzoate+sodium metabisulphite+4°C, BM room: Sodium benzoate+sodium metabisulphite+room temperature

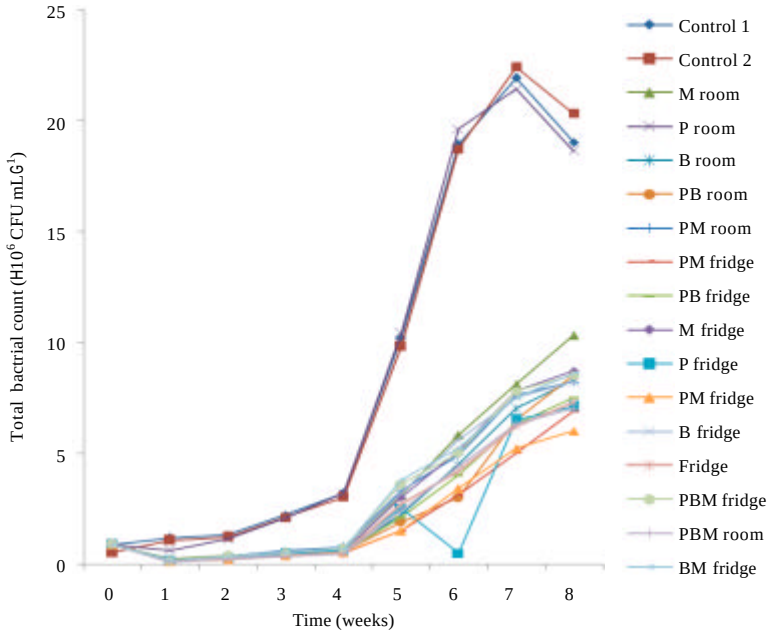

Fig. 1: Changes in the total bacterial count of agadagidi for 8 weeks, Control 1: Sample without any preservative at room temperature, Control 2: Laboratory prepared sample without any preservative at room temperature, B fridge: Sodium benzoate+5°C, Fridge: 5°C, PB fridge: Sodium benzoate+pasteurization+5°C, M fridge: Sodium metabisulphite+5°C, PM fridge: Pasteurization+sodium metabisulphite+5°C, P fridge: Pasteurization+5°C, Fridge: Samples stored at 5°C, PBM fridge: Pasteurization+sodium benzoate: Sodium metabisulphite+4°C, PBM room: Pasteurization+sodium benzoate+sodium metabisulphite+room temperature, BM fridge: Sodium benzoate+sodium metabisulphite+4°C, BM room: Sodium benzoate+sodium metabisulphite+room temperature

microbial load (Fig. 1, 2). Bacterial and fungal counts of the treated samples increased from an initial 0.88 and 1.28×10^6 CFU mL^{-1} to between 6.00-8.60 and 1.95-2.37 CFU mL^{-1}, respectively. This was also observed by Efiuvwevwere and Akoma (1997), Inyang and Dabot (1997), Omojowo *et al.* (2008-2010) and Nkama *et al.* (2010), who preserved a variety of foods from a period 2 to 8 weeks. The marked decrease in the total counts of bacteria and fungi after pasteurization, refrigeration at 5°C and addition of chemical preservatives suggests the effectiveness of the preservative treatments used for the agadagidi samples (Fig. 1, 2). The initial high alcohol content of the samples of between 3.0-4.0% is also thought to have a synergistic effect with the chemical preservatives on microbial numbers in the agadagidi samples (Fig. 5). However, the fungal and bacterial numbers began to increase from the 1st and 4th week of storage, respectively. This may be because of the pH of the agadagidi; pH 6.5 which dropped gradually to 5.2 during storage which favored the multiplication of fungi over bacteria (Fig. 3, 4) and the reduced effect of the preservatives over time (Banwart, 2004).

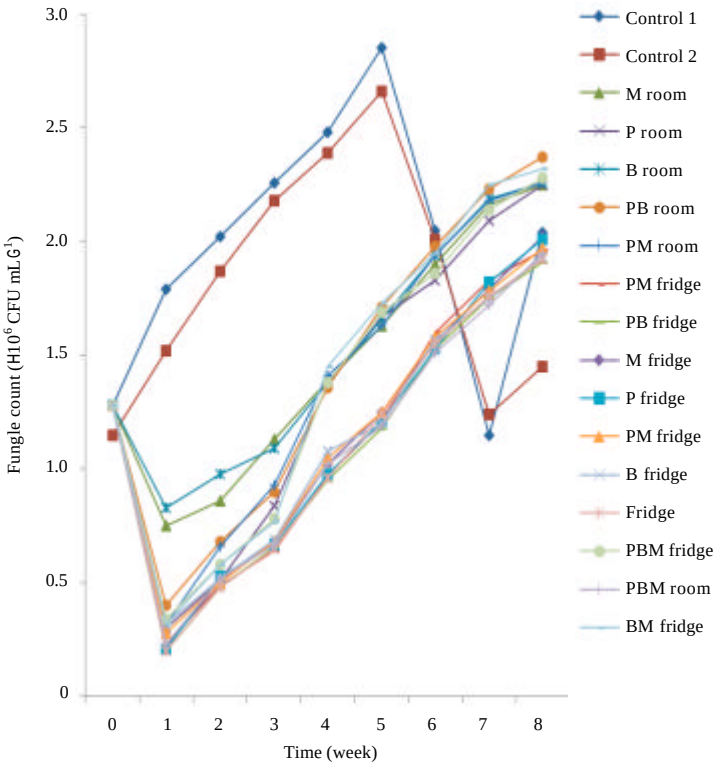

Fig. 2: Changes in the total fungal count of agadagidi for 8 weeks, Control 1: Sample without any preservative at room temperature, Control 2: Laboratory prepared sample without any preservative at room temperature, B fridge: Sodium benzoate+5°C, Fridge: 5°C, PB fridge: Sodium benzoate+pasteurization+5°C, M fridge: Sodium metabisulphite+5°C, PM fridge: Pasteurization+sodium metabisulphite+5°C, P fridge: Pasteurization+5°C, Fridge: Samples stored at 5°C, PBM fridge: Pasteurization+sodium benzoate: Sodium metabisulphite+4°C, PBM room: Pasteurization+sodium benzoate+sodium metabisulphite+room temperature, BM fridge: Sodium benzoate+sodium metabisulphite+4°C, BM room: Sodium benzoate+sodium metabisulphite+room temperature

The decrease in pH from 6.58±0.01 to between 5.12±0.01-5.48±0.00 and concomitant increase in the acidity of the samples from 0.137±012 to between 0.310±0.00-0.420±0.00 is attributed to the activities of the yeasts and other isolated microorganisms (Fig. 3, 4). The acidity creates an unfavorable environment for pathogenic bacteria such as members of Enterobacteriaceae (Olotu *et al*., 2009). This was also reported by Adeleke and Abiodun (2010) in the analysis of some local Nigerian beverages. The reduction in sugar content of the agadagidi samples from an initial 5.97±0.06% to between 1.47±0.06-4.80±1.00% (Fig. 6) was more pronounced in samples other than those treated with sodium benzoate and refrigeration at 5°C. This may be significant in that the maintenance of the sweet-sour taste of the agadagidi which is occasioned by the retention of the residual sugars is a factor in determining the acceptance

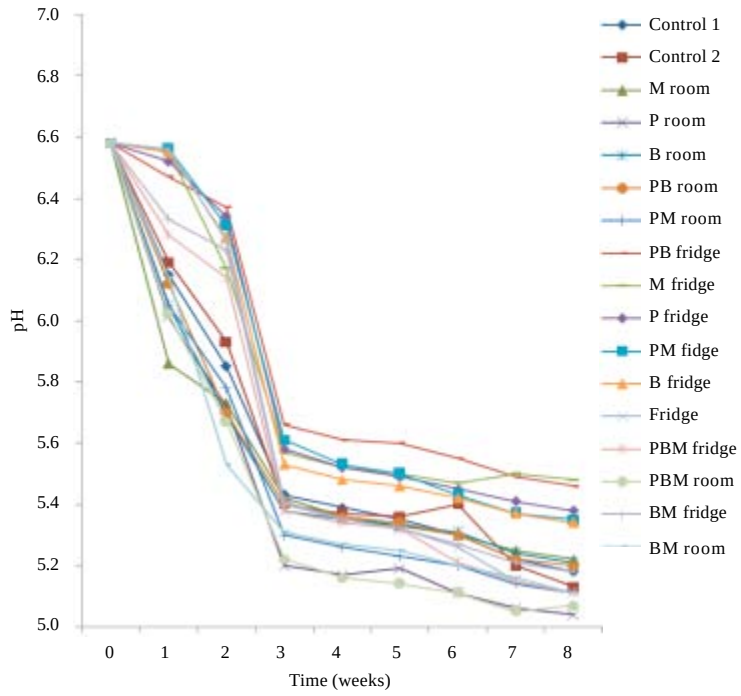

Fig. 3: Changes in the pH of agadagidi for 8 weeks, Control 1: Sample without any preservative at room temperature, Control 2: Laboratory prepared sample without any preservative at room temperature, B fridge: Sodium benzoate+5°C, Fridge: 5°C, PB fridge: Sodium benzoate+pasteurization+5°C, M fridge: Sodium metabisulphite+5°C, PM fridge: Pasteurization+sodium metabisulphite+5°C, P fridge: Pasteurization+5°C, Fridge: Samples stored at 5°C, PBM fridge: Pasteurization+ sodium benzoate: Sodium metabisulphite+4°C, PBM room: Pasteurization+sodium benzoate+sodium metabisulphite+room temperature, BM fridge: Sodium benzoate+ sodium metabisulphite+4°C, BM room: Sodium benzoate+sodium metabisulphite+room temperature

of the preserved agadagidi samples (Table 4). The shelf life of many products is determined by their taste and acceptance characteristics (Gimenez *et al*., 2008).

The observed changes during storage also included changes in the colour and aroma of the preserved agadagidi samples. A mildly fresh aroma was maintained in most of the samples in the 3rd week of storage except the control samples in which a vinegary smell was observed in the 1st an 2nd week, respectively. The samples labeled B fridge, PBM fridge and PB fridge retained the fresh aroma for 4 weeks until changes were observed in those samples in the 5th week for the sample BM fridge and the 6th week for the samples B fridge, PBM fridge and PB fridge. No change in colour was observed for all the samples during storage except the samples which preserved with sodium benzoate which were slightly darker than the usual light cream colour of agadagidi.

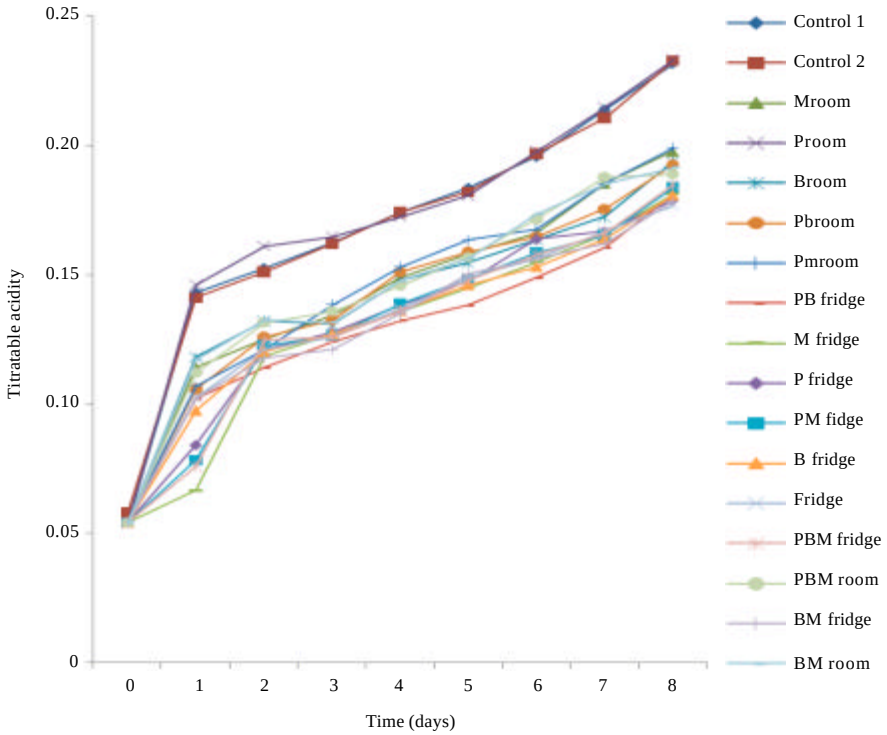

Fig. 4: Changes in the titratable of agadagidi for 8 weeks, Control 1: Sample without any preservative at room temperature, Control 2: Laboratory prepared sample without any preservative at room temperature, B fridge: Sodium benzoate+5°C, Fridge: 5°C, PB fridge: Sodium benzoate+pasteurization+5°C, M fridge: Sodium metabisulphite+5°C, PM fridge: Pasteurization+sodium metabisulphite+5°C, P fridge: Pasteurization+ 5°C, Fridge: Samples stored at 5°C, PBM fridge: Pasteurization+sodium benzoate: Sodium metabisulphite+4°C, PBM room: Pasteurization+sodium benzoate+sodium metabisulphite+room temperature, BM fridge: Sodium benzoate+sodium metabisulphite+4°C, BM room: Sodium benzoate+sodium metabisulphite+room temperature

Observations of the overall acceptability of agadagidi samples which received no chemical treatment deteriorated significantly ($p<0.05$) after the 1st week (Table 4). There was no significant difference between those samples preserved with pasteurization+sodium benzoate at 5°C (PB fridge) and samples preserved with pasteurization+sodium benzoate+sodium metabisulphite at 5°C (PBM fridge) on the 8th week neither was there significant difference between agadagidi samples preserved with sodium benzoate at 5°C (B fridge) and samples preserved pasteurization+sodium benzoate+sodium metabisulphite at 5°C (PBM fridge) on the 8th week (Table 4). This shows that the shelf life of agadagidi can be extended for 8 weeks using only sodium benzoate at 5°C (B fridge). Consumers are in a position to decide when a food product remains wholesome during storage (Gimenez *et al*., 2008) hence the scores (above 3 on a 5-point hedonic scale) of the overall acceptability of the agadagidi samples treated with sodium benzoate and stored

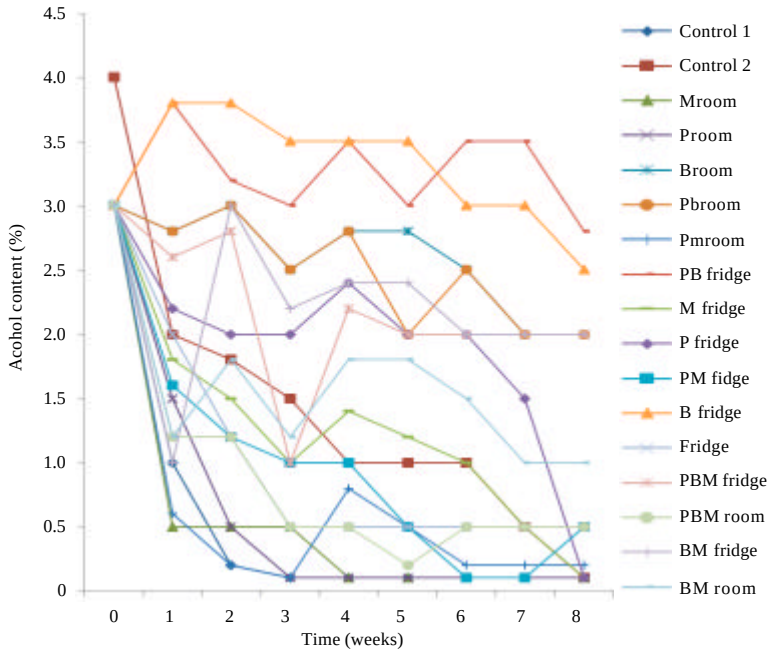

Fig. 5: Changes in the Alcohol content of agadagidi for 8 weeks, Control 1: Sample without any preservative at room temperature, Control 2: Laboratory prepared sample without any preservative at room temperature, B fridge: Sodium benzoate+5°C, Fridge: 5°C, PB fridge: Sodium benzoate+pasteurization+5°C, M fridge: Sodium metabisulphite+5°C, PM fridge: Pasteurization+sodium metabisulphite+5°C, P fridge: Pasteurization+5°C, Fridge: Samples stored at 5°C, PBM fridge: Pasteurization+sodium benzoate: Sodium metabisulphite+4°C, PBM room: Pasteurization+sodium benzoate+sodium metabisulphite+room temperature, BM fridge: Sodium benzoate+sodium metabisulphite+4°C, BM room: Sodium benzoate+sodium metabisulphite+room temperature

Table 4: Changes in overall acceptability of the agadagidi with storage for 8 weeks

	Period of storage (weeks)								
	0	1	2	3	4	5	6	7	8
Control 1	4.80±0.45^{a}	1.60±0.55^{a}	1.00±0.00^{a}	1.00±0.00^{a}	1.00±0.00^{a}	1.00±0.00^{a}	1.00±0.00^{a}	1.00±0.00^{a}	1.00±0.00^{a}
Control 2	4.80±0.45^{a}	1.60±0.55^{a}	1.00±0.00^{a}	1.00±0.00^{a}	1.00±0.00^{a}	1.00±0.00^{a}	1.00±0.00^{a}	1.00±0.00^{a}	1.00±0.00^{a}
M room	4.80±0.45^{a}	2.60±0.55^{b}	1.60±0.55^{a}	1.00±0.00^{a}	1.00±0.00^{a}	1.00±0.00^{a}	1.00±0.00^{a}	1.00±0.00^{a}	1.00±0.00^{a}
P room	4.80±0.45^{a}	1.60±0.55^{a}	1.00±0.00^{a}	1.00±0.00^{a}	1.00±0.00^{a}	1.00±0.00^{a}	1.00±0.00^{a}	1.00±0.00^{a}	1.00±0.00^{a}
B room	4.80±0.45^{a}	4.80±0.45^{d}	4.60±0.55^{e}	4.00±0.00^{d}	2.20±0.45^{b}	1.60±0.55^{b}	1.00±0.00^{a}	1.00±0.00^{a}	1.00±0.00^{a}
PB room	4.80±0.45^{a}	4.80±0.45^{d}	4.20±0.45^{de}	4.20±0.45^{d}	2.40±0.55^{b}	1.60±0.55^{b}	1.00±0.00^{a}	1.00±0.00^{a}	1.00±0.00^{a}
PM room	4.80±0.45^{a}	2.80±0.45^{b}	1.60±0.55^{a}	1.00±0.00^{a}	1.00±0.00^{a}	1.00±0.00^{a}	1.00±0.00^{a}	1.00±0.00^{a}	1.00±0.00^{a}
B fridge	4.80±0.45^{a}	4.80±0.45^{c}	4.80±0.45^{e}	4.80±0.45^{e}	4.80±0.45^{e}	4.20±0.45^{e}	4.00±0.00^{d}	3.60±0.55^{d}	3.00±0.00^{b}
PB fridge	4.80±0.45^{a}	4.80±0.45^{c}	4.80±0.45^{e}	4.80±0.45^{e}	4.80±0.45^{e}	4.00±0.00^{cd}	4.00±0.00^{d}	3.60±0.55^{d}	3.20±0.45^{b}
M fridge	4.80±0.45^{a}	4.20±0.45^{bc}	3.60±0.55^{d}	3.00±0.00^{c}	2.40±0.55^{b}	1.20±0.45^{a}	1.00±0.00^{a}	1.00±0.00^{a}	1.00±0.00^{a}
PM fridge	4.80±0.45^{a}	4.40±0.55^{c}	3.60±0.55^{d}	3.00±0.00^{c}	2.60±0.55^{b}	1.20±0.45^{a}	1.00±0.00^{a}	1.00±0.00^{a}	1.00±0.00^{a}
P fridge	4.80±0.45^{a}	3.60±0.55^{b}	2.40±0.55^{b}	1.60±0.55^{b}	1.00±0.00^{a}	1.00±0.00^{a}	1.00±0.00^{a}	1.00±0.00^{a}	1.00±0.00^{a}
Fridge	4.80±0.45^{a}	3.60±0.55^{b}	3.00±0.00^{c}	1.80±0.45^{b}	1.20±0.45^{a}	1.00±0.00^{a}	1.00±0.00^{a}	1.00±0.00^{a}	1.00±0.00^{a}

Table 4: Continue

	Period of storage (weeks)								
	0	1	2	3	4	5	6	7	8
PBM fridge	4.80±0.45^{a}	4.80±0.45^{c}	4.80±0.45^{e}	4.80±0.45^{e}	4.80±0.45^{e}	4.20±0.45^{e}	4.00±0.00^{d}	3.60±0.55^{d}	3.40±0.55^{b}
PBM room	4.80±0.45^{a}	4.60±0.55^{c}	4.60±0.55^{e}	4.20±0.45^{d}	3.40±0.55^{c}	2.60±0.55^{b}	1.80±0.45^{b}	1.20±0.45^{ab}	1.00±0.00^{a}
BM fridge	4.80±0.45^{a}	4.80±0.45^{c}	4.40±0.55^{e}	4.20±0.45^{d}	4.00±0.00^{d}	3.60±0.55^{c}	2.40±0.55^{c}	1.60±0.55^{bc}	1.40±0.55^{a}
BM room	4.80±0.45^{a}	4.60±0.55^{c}	4.40±0.55^{e}	4.00±0.00^{d}	3.60±0.55^{cd}	3.00±0.00^{b}	2.60±0.55^{c}	1.80±0.45^{c}	1.40±0.55^{a}

Each value is the Mean±SD of 5 panelists where 5: Very good, 4: Good, 3: Fair, 2: Poor, 1: Very poor. Different letters within each column are significantly different ($p<0.05$). Control 1: Sample without any preservative at room temperature, Control 2: Laboratory prepared sample without any preservative at room temperature, B fridge: Sodium benzoate+5°C, Fridge: 5°C, PB fridge: Sodium benzoate+pasteurization+5°C, M fridge: Sodium metabisulphite+5°C, PM fridge: Pasteurization+sodium metabisulphite+5°C, P fridge: Pasteurization+5°C, Fridge: Samples stored at 5°C, PBM fridge: Pasteurization+sodium benzoate: Sodium metabisulphite+4°C, PBM room: Pasteurization+sodium benzoate+sodium metabisulphite+room temperature, BM fridge: Sodium benzoate+sodium metabisulphite+4°C, BM room: Sodium benzoate+sodium metabisulphite+room temperature

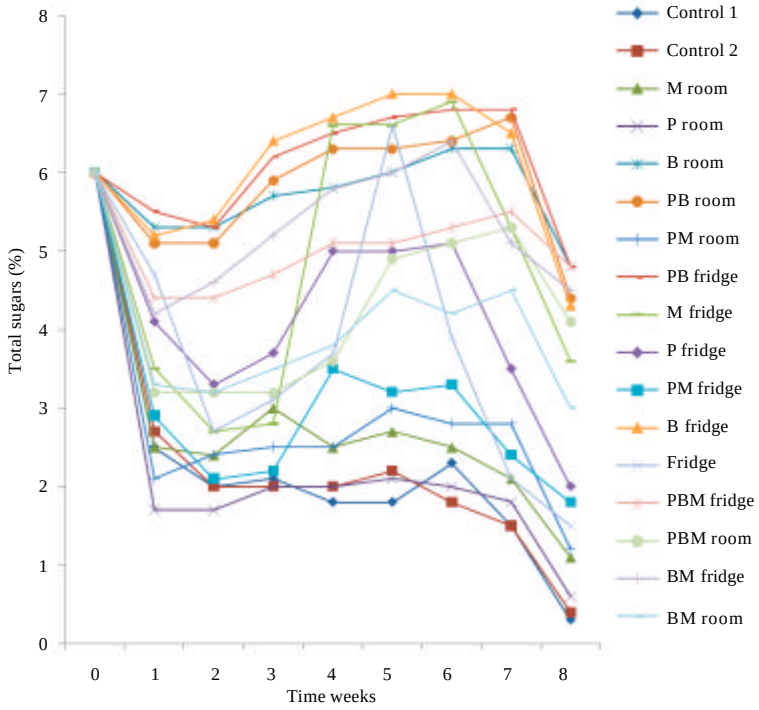

Fig. 6: Changes in the Sugar content of agadagidi for 8 weeks, Control 1: Sample without any preservative at room temperature, Control 2: Laboratory prepared sample without any preservative at room temperature, B fridge: Sodium benzoate+5°C, Fridge: 5°C, PB fridge: Sodium benzoate+pasteurization+5°C, M fridge: Sodium metabisulphite+5°C, PM fridge: Pasteurization+sodium metabisulphite+5°C, P fridge: Pasteurization+5°C, Fridge: Samples stored at 5°C, PBM fridge: Pasteurization+sodium benzoate: Sodium metabisulphite+4°C, PBM room: Pasteurization+sodium benzoate+sodium metabisulphite+room temperature, BM fridge: Sodium benzoate+sodium metabisulphite+4°C, BM room: Sodium benzoate+sodium metabisulphite+room temperature

at 5°C were favourable up to the 8th week. These samples are B fridge, PB fridge and PBM fridge (Table 4). This indicates the overall acceptability of the agadagidi samples up till the 8th week of storage.

CONCLUSION

The results in this study therefore suggest that the rapid deterioration of agadagidi can be prevented and the shelf life extended from the traditional 2 to 3 days to 8 weeks and still find consumer acceptability with the use of 0.1% sodium benzoate and refrigeration at 5°C which is recommended by this study.

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