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INFLUENCE OF PRE-TREATMENT ON THE MICROBIOLOGICAL AND BIOCHEMICAL PROPERTIES OF WINE PRODUCED FROM OVERRIPE PLANTAIN

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ABSTRACT

Wine is essential in every celebration but it is very expensive in countries where grape is not grown. *Agadagidi*, an effervescent wine analogue with sweet-sour taste is locally produced from overripe plantain which is abundant in the Tropics. This research produced *agadagidi* by sulphiting the must with or without inoculating with *Saccharomyces cerevisiae* strain isolated from spontaneous fermentation. Some of the samples were also pasteurized with a view to producing *agadagidi* with consistent quality. Microorganisms were enumerated, isolated and identified during storage, sugars, pH, TTA and sensory properties were also assessed using standard methods. The result showed that the range of TVC, LAB, and fungi count were 5.571 – 9.076 log cfu/ml, 2.717- 9.253 log cfu/ml and 4.079 - 9.418 log cfu/ml respectively. Microorganisms isolated were *Saccharomyces cerevisiae, Saccharomyces bayanus, Pichia kluyveri, Candida albicans, Bacillus pumilus, Lactobacillus plantarum, Bacillus subtilis* and *Leuconostoc oenos*. The reducing sugar was higher in unpasteurized samples than pasteurized sample at the beginning of storage. Total sugar generally decreased while the TTA increased during storage. The sensory score showed that all unpasteurized samples and pasteurized sample without isolate and sulphite were accepted by the panelists. This study therefore suggests the use of sulphite with or without starter culture in the production of *agadagidi* with consistent quality.

Keywords: microorganisms, sulphiting, pasteurization, *agadagidi*, sugar, sensory properties

INTRODUCTION

Wine is an alcoholic beverage produced from grape and other fruits with adequate level of fermentable sugars such as mango, pineapple, banana, plantain, pear, apple etc by spontaneous or controlled fermentation. It contains esters, sugar, aldehyde, tannin, pectin, acid (malic, tartaric and citric acid) vitamin and minerals **(Amerine *et al*., 2012; Zubia and Dizon, 2019).**
Plantain (*Musa paradisiaca*) is a staple food which is high in carotenoid (a precursor of vitamin A), vitamin B, C and minerals such as calcium, potassium, phosphorus and magnesium with low level of fat and sodium (**Kayode *et al*., 2013; Ibeanu et al., 2016; Bhuiyan *et al*., 2020**). It is usually consumed fried, boiled, roasted or processed into flour and meal for production of thin and thick porridge. It is also important in the production of composite flour for baking and confectioneries. Overripe plantain is a substrate for the production of *agadagidi*, an indigenous wine consumed in Africa. Overripe plantain contains fermentable sugar; glucose, sucrose and fructose (**Bhuiyan *et al*., 2020**) which serve as source of carbon for the fermenting microorganisms. Plantain is produced in abundance in West Africa, but due to high temperature, poor storage facilities and transportation, about 40% of the batch get spoilt before getting to market **(Odemero, 2013).**
Agadagidi is produced from overripe plantain by fermenting the must for 72 h and filtering thereafter. It has a cloudy appearance, it is effervescent and has sweet-sour taste **(Omojasola *et al*., 2012).** Fermentation of *agadagidi* is a way of preventing post-harvest loss of highly perishable plantain. This is because overripe plantain has very little or no economic value **(Areola *et al*., 2011).** Traditional fermented alcoholic beverages are consumed in Africa at home, in local bars and social gathering (**Oriola and Boboye, 2018).** Important microorganisms associated with locally fermented foods are lactic acid bacteria and yeast. They may be the natural microbial flora of the substrate or starter culture **(De Vuyst and Leroy, 2016; Malomo and Popoola, 2020).** Yeasts which are part of natural microbial flora of fruit takes part in the production of wine by producing metabolic substances and intermediate products that impact the final quality of wine positively or otherwise **(Cioch-Skoneczny *et al*., 2021)**. Some of the wild yeast isolated from fermentation of wine are Candida, Cryptococcus, Debaryomyces, Kluyveromyces, Pichia, Rhodotorula, Saccharomycodes, Schizosaccharomyces, Torulaspora and Zygosaccharomyces **(Pretorius *et al*., 2017)**. Yeast metabolizes sugar present in wine through glycolysis which is the process that convert glucose to pyruvate. Pyruvate is later converted to acetaldehyde by enzyme alcohol dehydrogenase and also give off carbondioxide in the absence of oxygen **(Alcamo and Warner, 2010; Zubia and Dizon, 2019).** Wine is sulphited to keep out microorganisms in order to prevent them from interfering with the activity of *Saccharomyces cerevisiae* or produce undesirable substances that may have negative effect on the desired quality (Kreiger – Weiber *et al*., 2020). Pasteurization reduces the population of spoilage and pathogenic microorganisms in food but thermophilic microorganisms and spore of bacteria are not affected (Onaolapo and Busari, 2014).
Many works have been done on *agadagidi* **(Adedeji and Abiose, 1994; Omojasola, 2012; Oriola and Boboye, 2018; Ajit *et al*., 2018)** but there is dearth of information on pre-treatment of *agadagidi* must before fermentation. This research studied the effect of pasteurization with or without addition of isolate or sodium metabisulphite on the microbiological and biochemical characteristics of *agadagidi*.

MATERIALS AND METHODS

Source of materials

Plantain was purchased from new market, Ile-Ife, Nigeria. Media and chemical used were of analytical grade

Preparation of plantain wine (*Agadagidi*) using natural fermentation

Overripe plantains were cleaned to remove extraneous materials and peeled. The pulps were homogenized in portable water at ratio of 1:5 (w/v) using blender, the mixture was dispensed into a plastic container, covered and fermented spontaneously for 72 h. The fermented must was filtered with clean muslin cloth **(Omojasola *et al*., 2012).** Yeast was isolated from the sample for further use in controlled fermentation using the scheme described by **Harrigan (1998).**

Isolation of yeast isolate

Agadagidi (5 ml) was homogenized in peptone water and appropriate dilution was dispensed into petridish. Molten potato dextrose agar was poured, allowed to solidify and incubated at 27 ºC for three days. Colony obtained was streaked on potato dextrose agar and the pure isolate obtained was re-streaked on slant agar in McCartney bottle. The isolate was viewed under the microscope, carbon assimilation and nitrite assimilation were also assessed. The pure isolate of *Saccharomyces cerevisiae* obtained was washed with 15 ml of sterile distilled water and centrifuged at 5000 rpm for 15 min. The cells pellet obtained was washed and centrifuged the second time and diluted to 10^7 cfu/ml **(Modified method of Oriola and Boboye, 2018).**

Preparation of plantain wine *(Agadagidi)* using controlled fermentation

Overripe plantains were cleaned and peeled. The pulps were homogenized in portable water at the ratio of 1:5 (w/v) using blender, the must was divided into six portions of 250 ml each; AA serve as the control, 0.1% sodium metabisulphite was added to AS, 10 ml of yeast isolate and 0.1% sodium metabisulphite was added to AIS, PA was pasteurized at 70 ºC for 15 min, PAI was pasteurized at 70 ºC for 15 min and 10 ml of yeast isolate was added; and PAIS was pasteurized at 70 ºC for 15 min, 10 ml of yeast isolate and 0.1% sodium metabisulphite was added and each must was fermented for 24 h and filtered with sterile muslin cloth. Each filtrate was dispensed into a sterile plastic bottle, covered and stored at room temperature for three weeks.

Microbiological analysis

Agadagidi (5ml) was homogenized in 45 ml of peptone water and the mixture was diluted appropriately. The representative dilution of each *agadagidi* sample was dispensed into sterile petri dish and about 20 ml of molten nutrient agar was poured for total viable count, De Man Rogosa and Sharpe agar for lactic acid bacteria and potato dextrose agar for fungi count and plates were incubated at 35 ºC for 24 h, 35 ºC for 48 h and 27 ºC for 3-5 days respectively. The resulting colonies were counted using colony counter and pure isolates were obtained by streaking colonies on solidified agar. Each pure isolate obtained were transferred into separate McCartney bottles and stored at 4 ºC **(Harrigan, 1998; Malomo, 2018).** Bacteria isolates were identified base on the cultural and morphological characteristic, Gram's staining reaction and biochemical tests **(Harrigan, 1998).** Yeast isolates were identified using colony characteristics, mode of reproduction, ability to assimilate carbon and nitrate **(Barnett *et al*., 2000).** Mould isolates were identified using the colour of growth on agar and microscopic (Leica DM500 13613210) characteristics such as hyphae, type of spores, mode of reproduction and special structures **(Harrigan, 1998).**

Determination of total reducing sugar of *agadagidi*

Agadagidi was filtered with Whatman No 1 filter paper and the filtrate (1 ml) was dispensed into test tube. Dinitrosalicyclic acid reagent (2 ml) was added and boiled for 5 min at 100 °C in a water bath (Gallenkomp, HH-S6, England). The test tube was cooled under running water and 7 ml of distilled water was added. Absorbance was read against reagent blank at 540 nm in a UV Spectrophotometer (Spectrumlab 752S, YM1206PHB2, China). Total reducing sugar in each *agadagidi* sample was extrapolated from a standard curve of known concentrations of glucose (0-1000 µg/ml) **(Adepoju *et al*. 2016).**

Determination of total sugar of agadagidi

Total sugar was determined using anthrone reagent method of Morris (1948) described by Malomo *et al*. (2021). Each *Agadagidi* sample was filtered with Whatman 1 filter paper and the filtrate (1 ml) was dispensed into test tube. Anthrone reagent (4 ml containing 50 mg of anthrone and 1 g of thiourea in 100 ml of 66% sulphuric acid) was added and heated in a boiling water bath (Gallenkomp, HH-S6, England) for 10 min and rapidly cooled. Absorbance was read at 620 nm against blank using a spectrophotometer (Spectrumlab 752S, YM1206PHB2, China). The quantity of total sugar was obtained from the standard curve of known concentrations of glucose (10-100 mg/l).

Determination of pH

Each *agadagidi* sample (20 mL) was dispensed into a glass beaker and pH was determined by inserting the electrode of the pH meter after standardization with buffer solutions with pH 4 and pH 7. Values displayed on the screen was recorded **(AOAC, 2000).**

Determination of Total Titratable Acidity (TTA)

Sample (10 ml) was dispensed into a conical flask, diluted with 10 ml of distilled water and 2 drops of phenolphthalein indicator was added. The mixture was titrated against 0.1 N NaCl until the colour changed to pink (AOAC, 2000). Titratable acidity values were calculated as:

$$\% \text{ Tartaric acid} = \frac{\text{Volume of NaOH} \times 0.1 \times 7.5}{Weight\ of\ sample} \quad \text{eq1}$$

Sensory evaluation

Panelist (20) who are familiar with the taste of *agadagidi* were asked to evaluate the sample for colour, aroma, taste, appearance and overall acceptability using. 9-point Hedonic scale (9 = like extremely, 8 = like very much, 7 = like moderately, 6 = like slightly, 5 = neither like nor dislike, 4 = dislike slightly, 3 = dislike moderately, 2 = dislike very much, 1 = dislike extremely) **(Montgomery, 2004).**

Statistical analysis

Difference in mean of data obtained was evaluated using analysis of variance (ANOVA) on EXCEL (2018) and SPSS (2010). Sensory data was analyzed using principal component analysis on XLSTAT (2014).

RESULTS AND DISCUSSION

Changes in microorganisms during storage of *agadagidi*

The Total Viable Count (TVC) of *agadagidi* is shown in Table 1. TVC generally increased from 3.311 – 6.834 log cfu/ml at the beginning of storage to 5.571 – 9.076 log cfu/ml at the end of storage. Unpasteurized must fermented with sodium metabisulphite (AS) had the lowest TVC of 3.311 log cfu/ml followed by must pasteurized (PA) before fermentation with 4.135 log cfu/ml at the beginning of storage. Pre-treatment of must generally reduced the total viable count in all *agadagidi*samples at week zero. PA had the highest count from week one to week three while AS had the lowest from week zero to week two. Sulphiting significantly reduced ($P < 0.05$) the TVC in both pasteurized and unpasteurized samples during storage. The highest TVC count observed in PA could be due to survival of vegetative cells or germination of spores after pasteurization and the absence of chemicals or colonization with isolate which could reduce the growth of wild microorganisms. Pasteurization has been reported to inhibit spoilage microorganisms in food but not active against the spores; vegetative cell of thermophilic microorganisms can still survive pasteurization temperature **(Onaolapo and Busari, 2014).** Addition of sulphite to wine inhibits wild yeast and selectively allows *Saccharomyces cerevisiae* to grow and ferments wine to give it its desirable quality (**Costantini *et al*., 2009).**

Lactic acid bacteria count generally increased from 2.717 – 5.272 log cfu/ml at the beginning of storage to 5.021 - 9.253 cfu/ml at the end of storage. Pasteurization and addition of sulphite generally reduced the initial lactic acid bacteria counts. There was no significant difference ($P > 0.05$) in the LAB count of samples AS and AIS from week 2 to week 3 (Table 1) showing that the LAB isolated from the unpasteurized samples could withstand sulphiting (Table 1). This is very important because of malo-lactic fermentation is usually allowed in some types of wine. LAB are also important in wine production because of their ability to breakdown protein by producing proteolytic enzymes thereby reducing haziness (**Virdis *et al*., 2021**). Three genera of lactic acid bacteria namely, *Lactobacillacea*, *Streptococcaceae* and *Pediococcus*, have been reported to associate with grape, musts or wine (**Costantini *et al*., 2009**).

Fungi count ranged between 4.079 and 9.418 log cfu/ml during the period of storage (Table 1). It was lowest in PA (4.079 log cfu/ml) and highest in AA (6.824 log cfu/ml) at the beginning of storage. There was no significant difference ($P > 0.05$) between the fungi count of all the unpasteurized samples AA, AS, and AIS throughout the period of storage. PA had the lowest count (4.079 cfu/ml) at the beginning of storage and count was significantly different ($P < 0.05$) from other pasteurized samples PAI and PAIS at the beginning and the end of storage. PA had the highest count which was significantly different ($p > 0.05$) from other *agadagidi* samples at week three (9.418 log cfu/ml). This result showed that the *Saccharomyces cerevisiae* isolated from naturally fermented *agadagidi* was not significantly affected by sulphiting and the lowest fungi count recorded in PA showed that most fungi cannot withstand pasteurization temperatures. Saccharomyces which is mostly involved in natural fermentation of wine has been reported to possess ability to colonize wine environment during fermentation and it is not affected by sulphiting **(Virides *et al*., 2021).**

Table 1 Changes in microbial population (log cfu/ml) during the storage of *Agadagidi*

	Storage (weeks)			
Sample	**0**	**1**	2	3
Total viable count				
AA	6.832^{a}±0.213	5.932^{c}±0.059	4.445^{d}±0.062	8.300^{b}±0.113
AS	3.311^{e}±0.159	3.518^{e}±0.071	4.109^{e}±0.124	7.825^{c}±0.049
AIS	6.266^{ab}±0.3`8	5.123^{d}±0.156	4.141d^{e}±0.098	7.536^{bc}±0.044
PAI	5.365^{c}±0.146	7.716^{b}±0.226	5.164^{c}±0.079	5.571^{e}±0.116
PAIS	5.375^{c}±0.191	7.678^{b}±0.236	5.485^{b}±0.120	7.345^{d}±0.004
PA	4.135^{d}±0.039	9.787^{a}±0.997	8.222^{a}±0.032	9.076^{a}±0.101
Lactic acid bacteria count				
AA	4.277^{b}±0.185	6.068^{d}±0.091	7.582^{a}±0.170	5.021^{c}±0.016
AS	2.717^{c}±0.033	6.858^{c}±0.122	7.468^{ab}±0.046	5.881^{b}±0.150
AIS	3.452^{bc}±0.213	7.599^{b}±0.157	6.997^{ab}±0.008	5.992^{b}±0.120
PAI	5.382^{a}±0.056	5.741^{d}±0.072	5.931^{c}±0.079	5.131^{c}±0.059
PAIS	5.272^{a}±0.054	6.077^{d}±0.103	6.760^{abc}±0.099	6.038^{b}±0.054
PA	3.879^{b}±0.460	8.306^{a}±0.052	6.567^{bc}±0.556	9.253^{a}±0.126
Fungi count				
AA	6.824^{a}±0.115	7.246^{a}±0.076	6.723^{a}±0.035	8.423^{b}±0.01
AS	6.779^{a}±0.011	7.411^{a}±0.043	6.016^{a}±0.018	8.024^{b}±0.052
AIS	6.795^{a}±0.036	7.382^{a}±0.084	6.089^{a}±0004	8.271^{b}±0.042
PAI	5.463^{b}±0.120	6.691^{b}±0.209	5.989^{a}±0.002	8.091^{b}±0.016
PAIS	5.480^{b}±0.099	6.825^{b}±0.038	6.368^{a}±0.345	8.150^{b}±0.014
PA	4.079^{c}±0.018	7.501^{a}±0.042	6.575^{a}±0.487	9.418^{a}±0.378

AA- *Agadagidi*; AS-*Agadagidi* and sulphite, AIS- *Agadagidi* isolate and sulphite, PAI- Pasteurized *agadagidi* isolate, PAIS- Pasteurized *Agadagidi* isolate and sulphite, PA- Pasteurized *agadagidi*. Values are means ± standard deviation, values in the columns with the same superscripts are not significantly different at P > 0.05

Microorganisms isolated from *agadagidi*

The microorganisms isolated from *agadagidi* were *Saccharomyces cerevisiae, Lactobacillus plantarum, candida albicans, Bacillus subtilis, Leuconostoc mesenteroides, Bacillus pumilus* and *Pichia kluyveri* as shown in Figures 1 and 2. It was dominated by *Saccharomyces cerevisiae* followed by *Lactobacillus plantarum.* All microorganisms isolated were present in all *agadagidi* samples from week zero to week three except Bacillus spp. *Saccharomyces* is important in wine making because of the unique characteristic it possesses. It has high sugar fermentation ability, ability to tolerate high alcoholic content, ability to compete in a medium and colonize wine during fermentation **(Andorra *et al*., 2019).** *Pichia kluyveri* has received much attention in wine making and commercially available for wine production because of its ability to improve the quality of wine by producing aromatic substances such as thiols, terpenes and fruity esters during fermentation of glucose. It also produces antimicrobial agent that inhibits spoilage yeasts **(Vincente *et al*., 2021).** *Candida* spp has been shown to produce biofilm in wine and also causes spoilage of wine **(Perpetuini, 2021).**

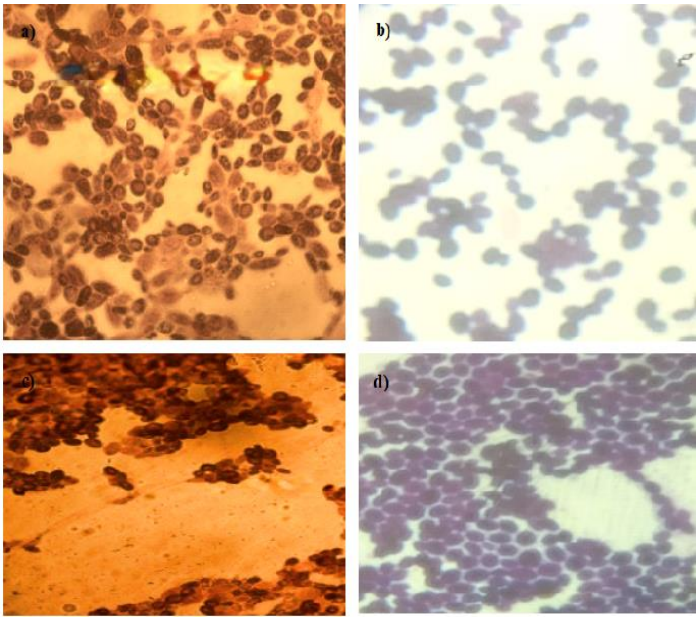

Figure 1 Yeast isolated from *agadagidi* (600 X magnification): a) *Saccharomyces cerevisiae;* b) *Saccharomyces bayanus;* c) *Pichia kluyveri*; d) *Candida albicans*

Lactic acid bacteria are important in wine production because of the conversion of malic acid to lactic acid which increases the desired wine aroma, impacts colour on wine due to the production of hydroxycinnamic acid from tartaric ester and the ability to break down anthocyanin glucosides. They also improve mouthfeel, stability of microorganisms during fermentation and reduce the acidity of wine **(Virdis *et al*., 2021)**. *Lactobacillus plantarum* has been shown to induce malolactic fermentation in wine even under the condition of high pH. Their metabolic activity also plays an important role in improving wine aroma which has led to consideration of some strains as part of the starter culture in wine production **(Du Toit *et al*, 2011; Krieger-Weber *et al*., 2020).**

Leuconostoc oenus is also important in malo- lactic fermentation and has been identified in palm wine **(Djeni *et al*., 2021)** and in wine produced from watermelon-banana and watermelon-pineapple mixture **(Omoya and Akharayi, 2008).** *Bacillus subtilis* and *Bacillus pumilus* were in PA, AA and PAI. It has been reported that Bacillus cannot survive in wine containing SO_2 **(Von Cosmos *et al*., 2017).**

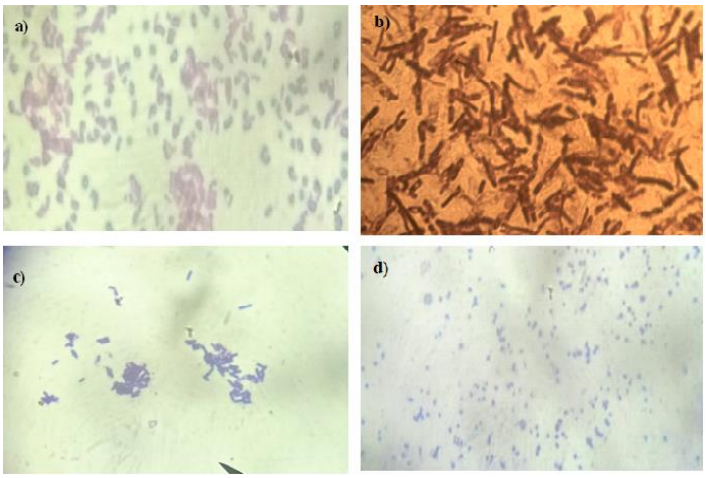

Figure 2 Bacteria isolated from *agadagidi* (1000 X magnification): a) *Bacillus subtilis; b) Bacillus pumilus; c) Lactobacillus Plantarum; d) Leuconostoc oenos*

Total sugar content of *agadagidi*

The total sugar content (Figure 3) generally decreased with increase in storage time. Addition of isolate and sulphite affected the utilization of sugars by microorganisms in unpasteurized samples AS and AIS probably due to the lower microbial load. Addition of isolate to PAI and PAIS increased the production of sugar in freshly fermented *agadagidi*. Total sugar was highest in AA while PA had the lowest at the beginning of storage. At the end of storage, AS had the highest while PA had the lowest. Low total sugar content of PA could be due to the presence of pre-gelatinized carbohydrate which increased the rate of conversion of sugar during fermentation. The fluctuation in the total sugar content during storage could be due to breakdown of carbohydrate into simple sugars which are utilized

by the microorganisms as carbon source to produce metabolites such as acid and ethanol. This result is in agreement with the findings of **Diaz *et al*. (2013)** who also reported decrease in total sugar with increase in days during fermentation of grape.

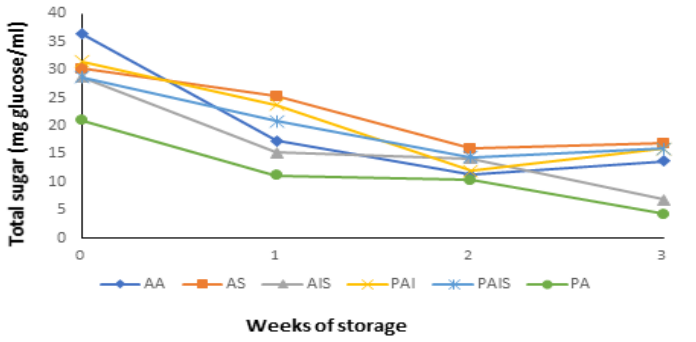

Figure 3 Effect of storage on the total sugar content of *agadagidi*. AA- *Agadagidi*; AS-*Agadagidi* and sulphite, AIS- *Agadagidi*, isolate and sulphite, PAI-Pasteurized *agadagidi*, isolate, PAIS- Pasteurized *Agadagidi*, isolate and sulphite, PA-Pasteurized *agadagidi*.

Reducing sugar content of the freshly prepared *agadagidi*

The reducing sugar (Figure 4) content of freshly prepared *agadagidi* ranged between (7.864 – 14.341 mg glucose/ml). It was highest in AS and lowest in PA. Sulphiting and addition of yeast isolate increased production of reducing sugar which could be due to hydrolysis of carbohydrate by activities of microorganisms in AS, AIS, PAI and PAIS. Pasteurized samples PA, PAI and PAIS generally had lower total reducing sugar (12.087 – 14.342 mg glucose/ml) than the unpasteurized samples (7.864 – 9.265 mg glucose/ml). This could be due to pre-gelatinization of carbohydrate which increased rate utilization of reducing sugar. The result obtained is in agreement with reducing sugar content of 12.3 mg/ml obtained from spontaneously fermented *agadagidi* **(Ajit *et al*., 2018).**

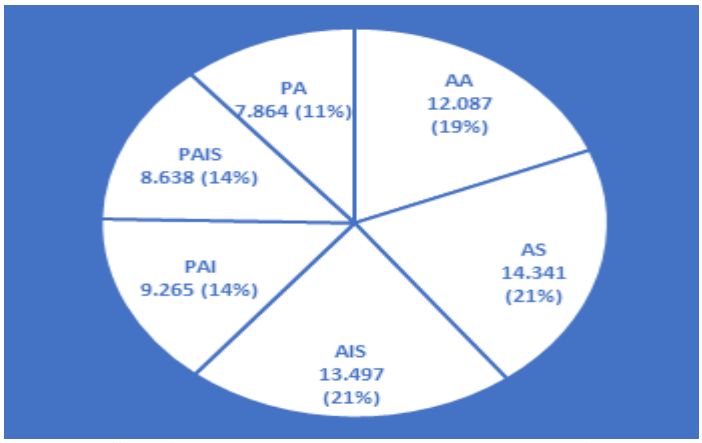

Figure 4 Effect of pasteurization, sulphiting and yeast isolate of must on the reducing sugar content (mg glucose/ml) freshly prepared *agadagidi*. AA-*Agadagidi*; AS-*Agadagidi* and sulphite, AIS- *Agadagidi*, isolate and sulphite, PAI-pasteurized *agadagidi*, isolate, PAIS- Pasteurized *Agadagidi*, isolate and sulphite, PA- Pasteurized *agadagidi*.

pH and Titratable acidity (TTA) content of *agadagidi*

The pH ranged between 5.28 and 5.39 at the beginning of storage (Figure 5). It increased in all samples at week 2 and then decreased progressively from week two to week three. AA had the lowest pH value range of 5.25 – 6.21 followed by PA with 5.28 – 6.21 during storage. Inoculation and sulphiting generally increased the pH of the samples. The TTA increased with increase in storage time as shown in Figure 6. TTA was within the range 0.59 – 0.60% at week zero. It was highest in PA (0.60%) and AS (0.60%) followed AA (0.59%) at the beginning of storage and was generally lower in inoculated samples AIS, PAI and PAIS (0.38 – 0.53%) than uninoculated samples AA, AS and PA (0.59 – 0.60%). It increased progressively in all samples and the values were higher in uninoculated samples AA, AS and PA than AIS, PAI and PAIS with AA having the highest throughout the period of storage. The values of TTA of *agadagidi* samples was within the range of 6.76 – 8.28 g/l recorded for red wine **(Cioch-Skoneczny *et al*., 2012).**

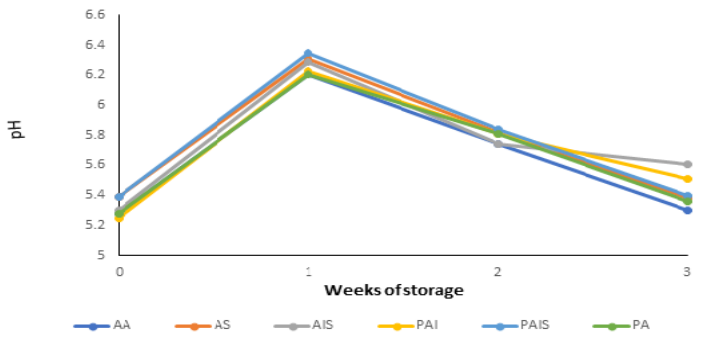

Figure 5 Changes in pH of *agadagidi* during storage. *AA- Agadagidi; AS-Agadagidi and sulphite, AIS- Agadagidi, isolate and sulphite, PAI- Pasteurized agadagidi, isolate, PAIS- Pasteurized Agadagidi, isolate and sulphite, PA-Pasteurized agadagidi.*

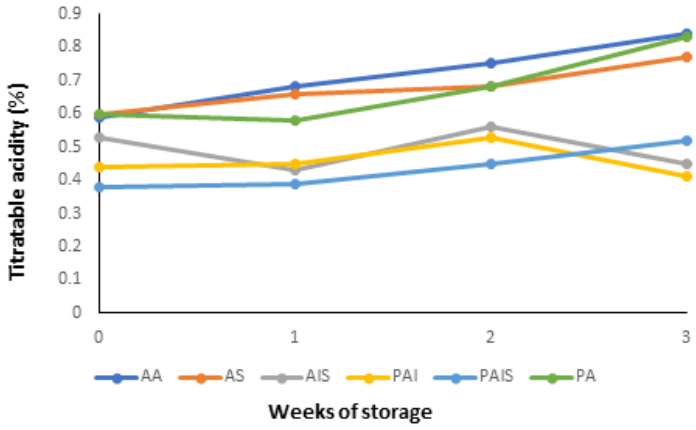

Figure 6 Titratable acidity of *agadagidi. AA- Agadagidi; AS-Agadagidi and sulphite, AIS- Agadagidi, isolate and sulphite, PAI- Pasteurized agadagidi, isolate, PAIS- Pasteurized Agadagidi, isolate and sulphite, PA- Pasteurized agadagidi.*

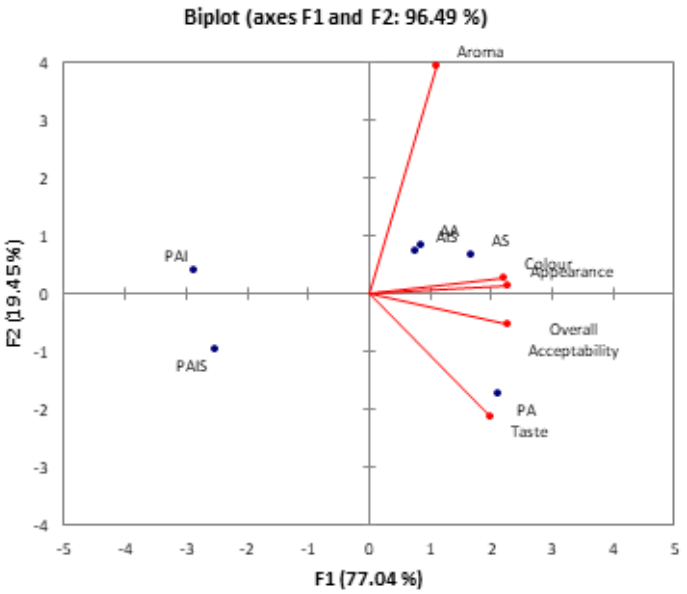

Figure 7 Biplot showing the relationship between samples and sensory parameters. AA- *Agadagidi*; AS-*Agadagidi* and sulphite, AIS- *Agadagidi*, isolate and sulphite, PAI- Pasteurized *agadagidi*, isolate, PAIS- Pasteurized *Agadagidi*, isolate and sulphite, PA- Pasteurized *agadagidi*.

The biplot showed the relationship between the sensory analysis of *agadagidi* samples (Figure 7). Principal component analysis divided the components into four factors with F1 accounting for 77.04% and F2 19.45%. Positive correlation exists within all unpasteurized samples AS, AIS and AA and they all had positive correlation with appearance, taste, colour, aroma and overall acceptability. PA also had positive correlation with appearance, taste, colour and overall acceptability. Addition of yeast starter culture and sulphite to pasteurized *agadagidi* PAI and

PAIS had negative effect on the taste, colour, appearance, aroma and overall acceptability of *agadagidi.* This result concluded that combination of pasteurization and sulphiting with or without inoculation affected the desirable characteristics of *agadagidi*. It has been reported that wild yeast and lactic acid bacteria also produces some important metabolites that gives wine its desirable quality **(Virides *et al*., 2017).**

CONCLUSION

Agadagidi with consistent quality can be produced by sulphiting and addition of starter culture to the must before fermentation. Addition of sodium metabisulphite and yeast isolate to unpasteurized wine reduced the microbial population during fermentation and storage at room temperature. Pasteurization also reduced the microbial population but had negative effect on the organoleptic quality when inoculated and sulphited. Pasteurization had negative effect on the aroma of *agadagidi* showing that the process inhibited production of certain aromatic compound that could impact flavour on wine. This research concluded that *agadagidi* with consistent quality can be produced by sulphiting the must to inhibit microorganisms that could negatively affect the quality of wine with or without inoculating with *Saccharomyces cerevisiae*. This could encourage the production of *adadagidi* on large scale thereby reducing post-harvest loss of plantain. Further work should be done on addition of yeast food, filtration or addition of preservative to *agadagidi*.

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