# EFFECT OF BAOBAB (*ADANSONIA DIGITATA*) FRUIT PULP ON THE CHEMICAL PROPERTIES OF FULL – FAT AND LOW – FAT YOGHURTS

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## ABSTRACT
This study was conducted to determine the effects of different levels of baobab fruit pulp on chemical properties of full-fat and low-fat yoghurt. The yoghurts studied were produced using whole cow milk and powdered skimmed milk, respectively. The baobab fruit pulp was decorticated and sieved through a 0.2 mm mesh. The two yoghurt types were extended with baobab fruit pulp at 0%, 15%, 30% and 45% and evaluated for ash, total solids, protein, fat, titratable acidity and pH. The results showed that full-fat yoghurt with 30% BFP inclusion had the highest fat (3.13%), protein (4.08%), total solids (22.11%), ash (0.95%), titratable acidity (1.42%) and pH (3.19) while low-fat yoghurt with 15% baobab fruit pulp inclusion had the least fat (1.14%), highest protein (3.85%), total solids (21.11%), ash (1.18%), titratable acidity (1.27%) and pH (3.28). It was concluded that full-fat yoghurt extended with 30% baobab fruit pulp had improved the fat, protein, total solid, ash, titratable acidity and pH while low-fat yoghurt with 15% baobab fruit pulp concentration had the least fat but high protein, total solid, ash, titratable acidity and pH. Lower concentrations of baobab fruit pulp in low-fat yoghurt (15%) and full-fat yoghurt (30%) are efficient for yoghurt extension.

**Keywords**: Baobab, full – fat, low – fat, yoghurt, chemical properties.

## INTRODUCTION
The persistence problem of malnutrition in sub-Saharan Africa could be mitigated by developing simple and affordable dairy products. Yoghurt contains important nutrients such as amino acids, vitamins, minerals and fatty acids essential for good health (Allen *et al.*, 2006); it could therefore be used in solving the problem of malnutrition. Nowadays, consumers have become more health conscious (Liu, 2011), and thus focused on dairy products that prevent nutrition-related diseases and improve physical and mental well-being (Klaus, 2003). The potential to intensify consumer satisfaction by developing good quality yoghurts with new flavours and health benefits has been emphasized (Shori *et al.,* 2013). Recently, there has been an increase in the trends for dairy products fortification with fruits, juice and pulp of dry fruits (Desai *et al.*, 1994; Ghadge *et al.*, 2008) and fruit extracts (Aswal *et al*., 2012).
Among the indigenous fruits extracts widely available in the semi-arid regions, Baobab Fruit Pulp (BFP) is poorly utilized (Osman, 2004). According to Magdi (2004), BFP contains high amount of carbohydrate (76.2%), low protein (8.2%), extremely low fat (0.3%), metabolizable energy (320 kcal/100 g) and crude fiber (5.4%). The fruit pulp taste acidic due to the presence of organic acids such as citric acid, tartaric acid, malic acid and succinic acid as well as vitamin C (UNCTAD, 2005). Thus, extending yoghurt with BFP could complement the nutrient balance and health status of the consumers. However, there is inconsistency regarding the best concentration of BFP on yoghurt (Abdullahi *et al*. 2014; Zakari *et al*. 2017; Adelekan and Saleh, 2020). The present study therefore, aims at evaluating the effects of different inclusion levels of BFP on chemical properties of low-fat (LF) and full-fat (FF) yoghurts.

## MATERIALS AND METHOD
The experiment was conducted at the Department of Animal Science, Bayero University, Kano. Kano State lies between Latitude 9$^{o}$ 30' and 12$^{o}$ 30' North and Longitude 8$^{o}$ 42' and 9$^{o}$ 30' East in northern Nigeria. The monthly precipitations of 0 to 30 mm were recorded in January to June and 780 to 1320 mm in July to December with an average temperature of 11 to 44 $^{o}$C (KNARDA, 2001).

**Yoghurt production and inclusion of Baobab Fruit Pulp**

Full fat and low-fat milk were processed into yoghurt as described by Tamime and Robinson (2004). The two milk types were pasteurized at 65 $^{o}$C for 30 minutes then cooled to 45 $^{o}$C and inoculated with Yougourmet® starter culture, a mixed strain of *Lactobacillus bulgaricus* and *Streptococcus thermophilus*. The yoghurt was extended with BFP at the dosage of 15%, 30% and 45% and the control 0% (v/v). Vanilla flavor (15 ml/L), sugar (30 g/L), sodium benzoate (2 g/L) and cornstarch (0.2%) were added to the yoghurt. Yoghurt samples were then labeled and packaged into 500 ml plastic containers and stored in refrigerator at 7 $^{o}$C for analysis.

**Chemical Analysis**

The chemical parameters which include: pH, titratable acidity, ash content, fat, total solids and protein were analysed according to the method described by AOAC (2007).

**Experimental design and data analysis**

The experiment was conducted in a 2x4 factorial arrangement of a CRD which comprised of two yoghurt types (full-fat and low-fat) at four levels of BFP (0%, 15%, 30% and 45% (v/v)). Data were analysed for variance using general linear model procedure of Statistix 10. Means were separated using Tukey-HSD at 5% level of probability.

## RESULTS AND DISCUSSION

The results of chemical composition (%) of yoghurt extended with BFP at different concentrations is summarised in Table 1. The fat content on FFY extended with BFP at 30 and 45% were highest while LFY extended with BFP at 15 and 30% recorded the lowest. This could be due to partial skimming of LFY. The results were in line with 3.05% obtained by Hernandez and Park (2014) in commercial cow milk yoghurt. However, the values were lower than those reported by Akalin (1993).

The total solid content of FFY extended with BFP increased with increase in the dosages of BFP and were higher compared to LFY. This could be attributed to the high fat and protein content as total solids is a combination of fat and solids not fat (SNF). Lower values of (12.81 and 12.20%) were reported by Eissa *et al*. (2011) for cow and camel yoghurt which are influenced by the fermentation process, draining of yoghurt, cooking and manufacturing utensils. The increase in total solids (TS) for LFY extended with 15% (21.11%) and 30% (25.55%) BFP could be linked to the addition of sucrose. The use of sucrose increases the total solids of the mix and strengthens the gel network. Olugbuyiro and Oseh (2011) reported a similar value of 21.8% in Mr. Cream Yoghurt in Nigeria. The increased solids content in yoghurt milk as a result of fortification also creates increased buffering that requires additional acid development by the starter cultures. The lowest value of 17.78% recorded in the control was due to the BFP added at zero level and was in line with the findings of Kavas *et al*. (2003) This could be due to the less probable fat loss during the ultrafiltration of the milk.

The highest total protein content of 4.08% in FFY extended with 30% BFP was higher than the 3.60 and 3.40% reported by Tamime and Robinson (1989) and Muhammad *et al*. (2006), respectively. This showed that yoghurt extended with BFP had no effect on protein content of the yoghurt. The ash content value of 0.68 in FFY extended with 15% BFP was within the range of 0.66 to 0.99% recorded by Ayar *et al*. (2006) for different fruit added yoghurts. Muhammad *et al*. (2008) also reported ash content value of 0.64-0.69% for commercial yoghurt. The highest ash content (1.35%) in LFY could be traced to partial removal of fat during skimming which concentrates total solids at the expense of fat and also BFP known to contain ash.

Muhammad *et al*. (2009) reported a titratable acidity (TA) range of 0.88 to 3.29% for whole cow milk yoghurt and 0.76 to 3.21% for powdered milk yoghurt which were within the ranges (1.27 to 1.57%) obtained in this study for FFY and LFY extended with BFP. Similarly, Laye *et al*. (1993) reported TA range of 0.90 to 1.10% in plain nonfat yoghurt. However, lower values of TA were reported by Anjum *et al*. (2007); Gad *et al*. (2010) and were within the ranges 0.83 to 0.96% and 0.94 to 0.98%, respectively. These could be attributed to controlled incubation and postproduction handling, formation of lactic acid produced by lactic acid bacteria present in yoghurt during storage and addition of date palm fruit.

The pH value obtained on FFY extended with BFP at 0% was higher than LFY at the four different levels. These results were lower than reports by Younus *et al*. (2002); Eissa *et al*. (2011). A yoghurt pH of 4.50 were reported by Salji *et al*. (1985) and Sutherland and Varnam (1994). The decrease in pH in LFY extended with BFP could possibly be due to acidity of starter culture as well as addition of BFP.

Table 1: Chemical composition (%) of yoghurt extended with BFP at different concentrations.

| | Yoghurt type | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | FFY | | | | LFY | | | | | |
| Property | 0 | 15 | 30 | 45 | 0 | 15 | 30 | 45 | SE | P value |
| Ash | 0.83 | 0.68 | 0.95 | 1.02 | 0.99 | 1.18 | 1.35 | 1.02 | 0.162 | 0.16 |
| TS | 17.78 | 18.89 | 22.11 | 35.56 | 16.79 | 21.11 | 25.55 | 22.22 | 4.473 | 0.06 |
| Protein | 2.44 | 2.32 | 4.08 | 3.06 | 3.68 | 3.85 | 3.46 | 3.74 | 0.584 | 0.08 |
| Fat | $2.63^{ab}$ | $2.79^{ab}$ | $3.13^{a}$ | $3.05^{a}$ | $2.02^{bc}$ | $1.14^{d}$ | $1.17^{d}$ | $1.57^{cd}$ | 0.240 | 0.007 |
| TA | $1.70^{a}$ | $1.61^{ab}$ | $1.42^{abcd}$ | $1.57^{abc}$ | $1.31^{cd}$ | $1.27^{d}$ | $1.40^{bcd}$ | $1.30^{cd}$ | 0.084 | 0.03 |
| pH | 3.48 | 3.19 | 3.19 | 3.01 | 2.96 | 3.28 | 3.15 | 2.73 | 0.177 | 0.12 |

$^{abcd}$ means with different superscript in a row are significantly different ($p<0.05$); SE = Standard error; FFY – full fat yoghurt; LFY – low fat yoghurt; TS – total solids; TA – titratable acidity.

## CONCLUSION AND RECOMMENDATION

It was concluded that FFY extended with 30% BFP had increased fat, protein, total solid, ash, titratable acidity and pH while LFY with 15% BFP concentration had the least fat but high protein, total solid, ash titratable acidity and pH. Lower inclusion levels of BFP for LFY (15%) and FFY (30%) are good enough for yoghurt extension.

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