***Original Research Article***

# Comparative Study on the Proximate Composition, Functional and Sensory Properties of Turmeric (*Curcuma longa*) and Pawpaw (*Carica papaya*) Custard Products



**ABSTRACT**

**Aim:** To advance the creation of variety through food product development and innovation, a comparative study of custard products with Turmeric (*Curcuma longa*) and Pawpaw (*Carica papaya*) was done.

**Study design:** This study was made to fit into a one way Analysis of Variance.

**Place and Duration of Study:** The research was carried out at the Department of Food Science and Technology laboratory, Federal University of Technology, Owerri, Nigeria, between March 2017 and August 2018.

**Methodology:** Different ratios of corn starch to pawpaw or turmeric were used in the custard product while a commercial custard product was used as the control. The samples were evaluated for proximate composition, microbiological analysis, functional and sensory properties.

**Results:** The water absorption capacity (1.44% to 1.64%), swelling index (5.27% to 6.77%), bulk density (0.68% to 1.55%) and gelation concentration (6.47% to 8.62%) of the turmeric treated custard and pawpaw treated custard were significantly different ($P<0.05$) from the control sample. The pawpaw treated custard had a higher protein and ash content compared to turmeric treated custard and control. With regards to the general acceptability of the custard products, the control was much accepted while the pawpaw sample was moderately accepted by the panellist. Microbial result showed that the pawpaw treated custard had an acceptable level of *Streptococcus spp*. The contamination level in the pawpaw treated custard, turmeric treated custard and the control were below the safety level recommended by International Microbiology Standard Limits for *pseudomonas spp*.

**Conclusion:** The development of these custard products showed that pawpaw treated custard is acceptable and may compete favourably in the market since it has better aroma than some commercial custard present in Nigeria. It is also important to pay close attention to the handling and processing of these products so as to promote food product safety.

*Keywords: corn starch, custard, pawpaw, product development, turmeric*

## 1. INTRODUCTION

Custard powder is a fine particulate food product made from corn starch with the addition of salt, flavour, colour with or without the inclusion of egg solids, vitamins and minerals. It can serve as a supplement to infant feeding and can be consumed as breakfast meal by many. It can be regarded as food of choice for the sick [1]. Custard powder is also produced by mixing powdered corn starch, food colour, powdered milk, flavour essence, etc. It is prepared by mixing a desired quantity of custard powder with little quantity of water to form a mixture, followed by gradual addition of hot boiled water into the mixture and then stirred continuously till the required gruel thickness is achieved. Custards come in different variations and flavours but predominantly contains corn starch which is mainly carbohydrate. On this note, it is important to improve the nutritional content of custard by creating a new variety of the product through incorporation of fruit and spice like pawpaw and turmeric respectively.

Pawpaw (*Carica papaya)*, belongs to the botanical family of *Caricaceae*. The fruit is a large berry of about 15-45cm long and 10-30cm in diameter. When ripe, the fruit is a bit soft and the skin turn from green to amber, orange or yellow [2].Two common types are grown in Nigeria, one has sweet red flesh and the other has yellow flesh [3]. Fresh and nutritious fruits like pawpaw are always faced with the menace of post-harvest losses probably because they are highly perishable as a result of their high moisture content and also due to poor storage facility, thus leading to spoilage, wastages and economic losses. Therefore there is need for more research to be carried out on the useful application of pawpaw fruit to prevent post-harvest losses.

On the other hand, turmeric (*Curcuma longa*) is a rhizomatous herbaceous perennial plant of the Zingiberaceae family [4]. This rhizome is usually boiled, dried, ground (milled) and used as colouring agent. The use of turmeric has been employed in food stuff, cosmetic, and medicine. It is widely used as spice in cooking. It gives curry its distinctive yellow colour and flavour. It is used as colouring agent in cheese, butter, and other foods [5]. The incorporation of turmeric into custard will improve the product colour and promote the nutritional/health benefits of the product probably because of the antioxidant properties of turmeric spice.

Processing and transformation of custard through product development by addition of pawpaw fruits which is a good source of vitamin, mineral and organic acids together with turmeric spice will add varieties to the already existing custard products and also encourage the utilization of locally available agricultural products as well as avoid wastages and reduce post-harvest losses. Food product development and innovation is always about creating variety and developing differentiated food products that meets the changing demands of consumers. Therefore, the aim of this work is to carry out a comparative study on custard products incorporated with pawpaw and turmeric.

## 2. MATERIALS AND METHOD

### 2.1 Sample Procurement

Some high quality white corn were bought from a local market in Owerri, Imo State. Vanilla flavour, powdered milk, sugar, vitamin C powder, sodium Benzoate, and sodium metabisulphate were purchased from a Chemical shop in Aba, Abia State. Pawpaw fruits were obtained from a farm in Owerri, Imo State while turmeric powder was obtained from the spice research laboratory, Raw Material and Research and Development Unit (RMRDU), Federal University of Technology Owerri, Nigeria.

## 2.2 Sample Preparation

### 2.2.1 Preparation of Corn Starch

The Starch extraction of cassava tubers were carried out according to the methods described by Osuji and Anih [6] with slight modification. The corn kernels were washed and steeped for 48 hours with sodium metabisulphite (5g/l). The germ was separated from the corn kernel and the endosperm was wet milled into slurry. The slurry was stirred and allowed to settle for about 6 hours. A heterogeneous mixture was observed. The top part of it was a transparent liquid while the bottom part was a thick liquid (the starch). The supernatant was decanted and the sediment filtered with muslin cloth and oven-dried at 70°C for 2 hours to produce the dry starch.

### 2.2.2 Preparation of Paw-Paw Powder

The pawpaw fruits were thoroughly washed before peeling. The seeds were removed and the fruits were sliced into chips prior to oven drying. The chips were dried at $60^0$C for 24 hours. The dried pawpaw chips were milled with disc attrition mill then with a blender to get smoother pawpaw powder which was sieved. The paw-paw powder was packed in an airtight container.

### 2.2.3 Preparation of Custard Powder

The custard powder was produced by mixing the ingredients: Premixing was done by taking a small quantity of corn starch and mixing with the other ingredients according to the formulation. The mixture was then poured into the remaining portion of corn starch and thoroughly mixed to get a homogenous mixture without pellets. The pawpaw custard product and turmeric custard product were packed separately in an air tight container prior to quality analyses.

**Table 1: Product Formulation of the Pawpaw Custard and Turmeric Custard**

| Raw Material (Ingredient) | Percentage Proportion (%) | Quantity (g) |
|---|---|---|
| Pawpaw- Custard (PC) | 30:70 | (60 + 140) = 200 |
| Tumeric-Custard (TC) | 10:90 | (20 + 180) = 200 |
| Milk | 30 | 60 |
| Sugar | 2.75 | 5.5 |
| Vitamin C | 0.15 | 0.3 |
| Sodium Benzoate | 0.0005 | 0.001 |
| Vanilla flavour | 0.60 | 1.2 |

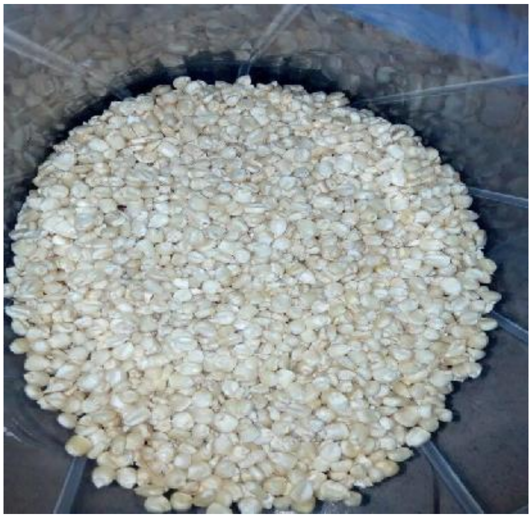

Plate 1: White Corn prior to Corn starch production

Plate 2: *Carica papaya* (Pawpaw) fruits

Plate 3: *Curcuma longa* (Turmeric) Roots and Powder

Plate 4: Packed Samples of Pawpaw-Custard and Turmeric-Custard Products

## 2.3 Proximate Composition of Custard Powder

The method of A.O.A.C. (2000) was used for the determination of moisture content, fat, crude protein, crude fibre and ash determination, while Carbohydrate was calculated by difference.

## 2.4 Functional Properties of Custard Powder

### 2.4.1. Least Gelation Concentration

The least gelation concentration (LGC) was determined by the methods described by Coffman and Garcia [7].

#### 2.4.2. Water Absorption Capacities (WAC)

The water absorption capacities (WAC) of the custard samples were determined by the method prescribed by AOAC [8].

#### 2.4.3. Bulk Density, Swelling power and Solubility

The swelling power and solubility were determined as described by Oladele and Aina [9].

## 2.5 Microbiological Analysis of Custard Powder

#### 2.5.1 Determination of Microbial Load (Bacteria and Fungi)

The method of the International Commission on Microbiological Specification for Foods, ICMSF [10] was adopted and used. One milliliter (1ml) of the prepared sample was diluted with 9ml of sterile distilled water (diluents) and mixed vigorously by shaking, 1ml of the resultant mixture was aseptically transferred to 9mls of sterile water in a test tube. This action was carried out under sterile aseptic conditions; and the dilution was continued serially until the 6th dilution was attained ($1X10^{-6}$)

One- tenth millilitre (0.1ml) of the $4^{th}$ and $6^{th}$ dilution were inoculated into already prepared sterile potato dextrose Agar (PDA) and nutrient Agar (N.A) plates respectively. The spread plate technique as illustrated by Pelezar and Chan [11] was employed. A flamed glass hockey stick shaped rod was used to spread the inoculum evenly over the surface of the agar in the plate .The arrangement was done in triplicate for the group B sample.

The PDA culture plates were inoculated at room temperature for 2 to 5 days, The NA culture plates were counted using Gallenkamp electronic colony counter .A mean of the counts from the triplicate was obtained and multiplied with the appropriate dilution factor to obtain the microbial loads as the total viable microbial colonies per unit weight of the sample expressed as the colony forming unit (CFU) per gram of the sample. It was calculated using the formula below;

$$\text{Cfu/g} = \frac{N \times D}{W} \qquad (1)$$

Where;
W = weight of sample analysed
N =Average number of colonies per plate
D =Dilution factor.

## 2.6 Sensory Evaluation

A group of 20 semi-trained panellists were selected from the campus of the Federal University of Technology Owerri (FUTO) and were asked to score the physical and quality attributes of the prepared custard samples. The parameters scored were: taste, aroma, colour and general acceptability of the products. A descriptive 9 – point hedonic scale as described by Ihekoronye and Ngoddy [12], was used to evaluate the product.

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

### 2.7 Data Analyses

The results of the functional, proximate, sensory, and microbial analyses were computed using one way Analysis of Variance (ANOVA) and Fishers Least Significant Difference (LSD) was used to establish the significance differences among the value at .05 level of confidence. The statistical analysis was computed using the program, IBM SPSS version 20.

## 3. RESULTS

**Table 2: Proximate Composition of the Custard Samples**

| Samples | MC % | DM % | ASH % | CF % | Fat % | CP % | CHO % |
|---|---|---|---|---|---|---|---|
| **PC** | $5.91^{b}$ | $94.16^{b}$ | $1.84^{a}$ | $1.36^{b}$ | $2.91^{a}$ | $4.72^{a}$ | $83.27^{c}$ |
| **TC** | $7.73^{b}$ | $92.28^{c}$ | $1.64^{b}$ | $1.30^{b}$ | $1.29^{b}$ | $3.61^{b}$ | $84.39^{b}$ |
| **CT** | $5.52^{c}$ | $94.49^{a}$ | $1.53^{c}$ | $0.66^{c}$ | $0.56^{c}$ | $2.67^{c}$ | $89.08^{a}$ |
| **LSD** | **0.30** | **0.31** | **0.05** | **0.27** | **0.09** | **0.10** | **0.41** |

Mean with different superscript in the same column are significantly different at (P = .05).
MC= Moisture Content, CHO= Carbohydrate, DM= Dry Matter, CF= Crude Fibre, and CP= Crude Protein.

**Table 3: Functional Properties of Custard Samples**

| Samples | WAC % | GC % | SP % | BD % |
|---|---|---|---|---|
| **PC** | $1.63^{a}$ | $6.47^{b}$ | $5.80^{b}$ | $1.55^{c}$ |
| **TC** | $1.44^{b}$ | $6.75^{b}$ | $5.27^{c}$ | $0.59^{b}$ |
| **CT** | $1.64^{a}$ | $8.62^{a}$ | $6.77^{a}$ | $0.68^{a}$ |
| **LSD** | **0.14** | **0.52** | **0.11** | **0.01** |

Mean with same superscript in the same column are not significantly different at ($P > 0.05$).
WAC= Water Absorption Capacity, GC= Gelation Concentration, SP= Swelling Power, BD= Bulk Density, LSD=Least Significant Difference.

**KEY:**
PC= Pawpaw-Treated Custard Powder
TC= Turmeric-Treated Custard Powder
CT= Control (Commercial) Custard Powder

**Table 4: Sensory Scores of the Custard Samples**

| **Sample** | **Colour** | **Taste** | **Aroma** | GA |
|---|---|---|---|---|
| **PC** | $7.10^{a}$ | $7.30^{a}$ | $7.90^{a}$ | $7.00^{a}$ |
| **TC** | $7.10^{a}$ | $4.30^{b}$ | $4.90^{b}$ | $5.20^{b}$ |
| **CT** | $7.10^{a}$ | $7.50^{a}$ | $7.20^{a}$ | $7.80^{a}$ |
| **LSD** | **1.79** | **1.35** | **1.36** | **0.92** |

Mean with same superscript in the same column are not significantly different at (P> 0.05).

**KEY:**
PC= Pawpaw-Treated Custard Powder
TC= Turmeric-Treated Custard Powder
CT= Control (Commercial) Custard Powder
GA = General Acceptability, LSD=Least Significant Difference.

**Table 5: Microbial Loads (Counts) of Custard Products**

| Sample | TBC ×$10^3$ | Proteus ×$10^3$ | Streptococcus ×$10^3$ | Pseudomonas ×$10^3$ | Bacillus ×$10^3$ | Staphylococcus×$10^3$ | TFC ×$10^2$ |
|---|---|---|---|---|---|---|---|
| **TC** | 67.00± 2.00$^a$ | 19.50±0.00$^b$ | 19.00 ±1.00$^a$ | 12.50 ±0.50$^b$ | 11.00 ±1.00$^b$ | 5.00 ±0.00$^b$ | 34.00 ±4.00$^b$ |
| **CT** | 45.00± 5.00$^b$ | 16.00 ± 1.00$^b$ | 13.00 ±1.00$^b$ | 12.00 ±2.00$^b$ | 12.00 ±2.00$^b$ | - | 13.50 ±0.50$^c$ |
| **PC** | 79.00± 1.00$^a$ | 25.00 ±2.00$^a$ | 5.50 ±0.5$^c$ | 25.00 ±2.00$^a$ | 25.00 ±2.00$^a$ | 12.00±2.00$^a$ | 52.00 ±2.00$^a$ |
| **LSD** | **14.23** | **5.95** | **3.90** | **7.46** | **7.80** | **5.81** | **11.69** |

Mean with same superscript in the same column are not significantly different at (P> 0.05).

**KEY:**
PC= Pawpaw-Treated Custard Powder
TC= Turmeric-Treated Custard Powder
CT= Control (Commercial) Custard Powder
GA = General Acceptability, LSD=Least Significant Difference.

## 4. DISCUSSION

### 4.1 Proximate Composition of Custard Samples

**4.1.1 Moisture Content**

The moisture content of the custard samples ranged from 5.91% to 7.73%. The samples were significantly different from each other ($P < 0.05$) with regards to moisture content. The turmeric treated sample had the highest value (7.73%) and the control sample had the lowest value (5.52%). From the result, the moisture content of the custard were relatively low (< 8%), suggesting that the shelf-life would be long. Ensminger *et al.,* [13] pointed out that the reduction of moisture content of any food production helps to enhance its suitability and adaptability for further use. The results for the dry matter of the samples were significantly different ($P < 0.05$) and ranged from 92.28% to 94.49%.This result showed that the control sample with the highest value of dry matter (94.49%) would have a longer shelf-life followed by the pawpaw treated sample (94.16%) and the least being the turmeric treated sample (92.28%).

**4.1.2 Ash Content**

The ash contents of the samples were significantly different ($P < 0.05$) from one another and ranged from1.53% to 1.84%. The pawpaw treated sample had the highest value for ash content (1.84%), followed by the turmeric treated sample (1.64%) and the control sample (CT) had the lowest ash content (1.53%). This result shows that the control sample had a lowest mineral content followed by the turmeric treated sample, with the pawpaw treated sample having the highest mineral content. According to Lienel [14], the ash content represents the total mineral content in foods.

**4.1.3 Crude Protein**

The protein contents of the samples ranged from 2.67% to 4.72%, with the control sample and the pawpaw treated sample being the lowest and highest respectively. The three samples were significantly different ($P<0.005$) with regards to their protein contents. The pawpaw treated sample had the highest value for protein which might be as a result of the protein from pawpaw. This view holds since the sample treated with turmeric was also higher in protein than the control sample.

**4.1.4 Fat Content**

The three samples were significantly different ($P<0.005$) with regards to their fat content. The control sample had the lowest fat content (0.56%), followed by the turmeric treated sample (1.29%) and the highest being the pawpaw treated sample (2.91%). Products with high fat content susceptible to rancidity, which leads to development of off flavour and odour. Also consumption of food products with high fat content could lead to obesity and other ill health conditions. Therefore low fat content in custards is desirable both to the processor and the consumer.

**4.1.5 Crude Fibre**

The control Sample had the lowest fibre content (0.66%), followed by the turmeric treated sample, with the pawpaw treated sample having the highest fibre content (1.36%). From the result of the fibre contents the pawpaw treated sample and the turmeric treated sample were not significantly different ($P > .05$) from each other, but were significantly different ($P < 0.05$) from the control sample. Fibre is one of the essential components that are often applied in enriched foods as a consequence of their demonstrated functions.

Fibre is considered as an efficient protective agent for a wide variety of illnesses, including cardiovascular disease, colon cancer and constipation [15]. Based on these views, the American Dietetic Association (ADA) recommended the inclusion of a variety of grains, mushrooms, vegetables, and fruits for an active and healthy life [16].

**4.1.6 Carbohydrate content**

All the samples had high values of carbohydrate. The values ranged from 83.27% to 89.08%, with the pawpaw treated samples and the control sample being the lowest and highest respectively. The samples differed significantly ($P<0.005$) from one another with respect to this component. The turmeric treated sample had a carbohydrate content of 84.39%. The high carbohydrate content of the custard samples showed that they are good source of energy for the body.

## 4.2 Functional Properties of Custard Samples

### 4.2.1 Water Absorption Capacity

The water absorption capacity of the pawpaw treated sample and turmeric treated sample were not significantly different (*$P > .05$*) from each other with regard to their water absorption capacity but differ significantly from the turmeric treated sample. The values ranged from 1.44% to 1.64% with the turmeric treated samples and control sample being the lowest and highest respectively. The pawpaw treated sample had a higher value (1.63%) than the turmeric treated sample. According to Abioye *et al.* [17], an increase in protein content leads to high water binding capacity which improves the reconstitution and textural stability obtained from custard.

### 4.2.2: Swelling Power

The swelling power of the samples were significantly different ($P < 0.05$) and ranged from 5.27% to 6.77%, with the turmeric treated sample and control sample being the lowest and highest respectively. The pawpaw treated sample had the second highest value of 5.80% which further buttressed the point that it had a better quality than the turmeric treated sample with respect to swelling power.

According to Onitilo, *et al.* [18] granule swelling capacity plays an important role in the rheological behavior of starch suspensions. When starch granules are heated with sufficient water, the crystalline structure is disrupted, which causes increased granule swelling.

### 4.2.3: Bulk Density

From the results obtained, there was significant difference ($P < 0.05$) between the samples. The pawpaw treated sample had the highest bulk density (1.55%) followed by the turmeric treated sample (0.59%) and the control sample had the lowest (0.68). According to Adejuyitan *et al.* [19], bulk density is a measure of the heaviness of flour, which also, is an important parameter that determines the ease of handling during transportation and processing as well as suitability for infant food formulation [20].

### 4.2.4: Gelation Concentration

The least gelation concentration of the formulated custard sample ranged from 6.47% to 8.62% with the pawpaw treated sample and the control sample being the lowest and highest respectively. The pawpaw treated sample and the turmeric treated sample were not significantly different ($P > .05$) with regard to their gelation concentration but differ significantly ($P < 0.05$) from the control sample. A high least gelation concentration means that the formulated product has increased capacity to provide the structural matrix for holding water, flavours, sugars and food ingredients, an attribute of practical importance in the development of new products [21].

## 4.3 Sensory Properties of Custard Samples

From the result of the sensory evaluation performed on custard samples ranged between 4.30-7.50 for taste, 4.90-7.90 for aroma, and 5.20-7.80 for general acceptability in the entire gruel. The control sample had the highest value for taste (7.50%) while the turmeric treated sample had the lowest value (4.30%). There was no significant difference ($P > 0.05$) in taste between the pawpaw treated sample and the control sample but they differed significantly ($P < 0.05$) from the turmeric treated sample. The pawpaw treated sample had the highest value for aroma (7.90%) while the turmeric treated sample had the lowest value (4.90%).The pawpaw treated sample and the control sample were not significantly different ($P > 0.05$) from each other in terms of aroma but differed significantly ($P < 0.05$) from the turmeric treated sample. For colour, the three samples were not significantly different ($P > 0.05$) from one another and all had same values (7.10%). This showed that the panellists had the same level of likeness for the samples. For general acceptability, the turmeric treated sample had the least score of 5.20% as compared to the pawpaw treated sample (7.00%) and the control sample (7.80%) which had the highest. The pawpaw treated sample and the control sample were not significantly different (P > 0.05) from the control sample.

## 4.4 Microbial Counts in the Custard Products

The custard samples, Pawpaw treated sample ($79\times10^3$ CFU/g) and the control sample ($45\times10^3$ CFU/g) had the highest and the lowest total bacteria counts (TBC) respectively. Although the pawpaw treated sample is significantly different ($P < 0.05$) from the control sample, it is comparable to turmeric treated sample, because they are not significantly different ($P > 0.05$). The higher moisture contents might be responsible for the higher microbial count of the turmeric treated sample and the pawpaw treated samples. This is in agreement with reports that high moisture content (high water activity) of custard product supports the growth of a wide range of bacteria [22, 23]. The total bacterial count of the custard samples were within the recommended limit ($10^5$ - $<10^6$CFU/g) prescribed by the international Microbiological standards for bacteria contaminants for food [24]. The result for the TBC was below the value ($15.05\times10^4$ CFU/g) reported by Awoyale *et al.* [25] for cassava starch based custard.

The *Proteus spp* contaminant was highest and lowest in pawpaw treated sample ($25\times10^3$ CFU/g) and the control sample ($16\times10^3$ CFU/g) respectively. The quantity of growth in the turmeric treated sample the control sample were not significantly different ($P > 0.05$), but significantly different ($P < 0.05$) from the pawpaw treated sample. *Proteus sp.* belongs to the family Entereobacteriaceae. Based on NSW food authority and Food Standard Austrial New Zealand (FSANZ) guidelines, the acceptable level of Enterobacteriaceae is $<10^4$ [26]. The results gave unacceptable levels of *Proteus spp* colonies. *Proteus spp.,* had been implicated as pathogen responsible for many human urinary tract infections [27].

*Streptococcus* growth in the custard samples showed that the turmeric treated sample ($19\times10^3$ CFU/g) and pawpaw treated sample ($5.5\times10^3$ CFU/g) had the highest and lowest value respectively. Many Species of *Streptococcus* had been known to be non-pathogenic [28]. However, pathogenic *Streptococcus spp.* are responsible for many cases of pink eye, meningitis, bacterial pneumonia, endocarditis, erysipel and necrotizing fasciitis [29]. The results obtained showed that the pawpaw treated custard had acceptable quantity of growths ($5.5 \times 10^3$CFU/g) based on the level sets by NSW Food Authority [26] and ICMSF [10].

The quantities of *Pseudomonas* growth in the samples showed that the pawpaw treated sample with the highest value ($25\times10^3$ CFU/g) is significantly different ($P < 0.05$) from the control sample ($12\times10^3$ CFU/g) and turmeric treated sample ($12.5\times10^3$ CFU/g). The turmeric treated sample contamination level was relatively higher than the level in the control sample. The contamination level in the pawpaw treated sample, and control sample were relatively higher than the limit recommended by the International Microbiological Standard for *Pseudomonas spp.* [24].

*Bacillus cereus* from Custard product has been implicated in food poisoning outbreaks [30]. Bacillus cereus contamination of the Custard samples in this study showed that the pawpaw treated custard ($25\times10^3$ CFU/g) and turmeric treated custard ($11\times10^3$ CFU/g) had the highest and the lowest count of colonies. The values obtained were higher than the recommended limits ($< 10^4$ CFU/g) by the International Microbiological Standards [10, 26]. The most important sources of *Bacillus spp.* are soil, water and vegetable. The relative higher value in the pawpaw treated sample might have resulted from the Papaya used, which could have been contaminated during the time of harvest or handling.

The *Staphylococcus aureus* growth count obtained showed that the pawpaw treated sample ($12\times10^3$ CFU/g) had the highest while no growth was observed in control sample. The contamination level of turmeric treated sample was within the acceptable limits $< 10^4$ CFU/g as recommended by the International Microbiological Standards [10, 26]. The most important source of *Staphylococcus* is the humans. These buttress the report of WHO [31] that about 40% of normal human adults harbours these organisms in the nose and throat, hence the fingertips of human are often contaminated.

The Total Fungi Count (TFC) in the Custard samples showed that pawpaw treated sample ($52\times10^2$ CFU/g) and the control sample ($13.50\times10^2$ CFU/g) had the highest and lowest count respectively. The result in this research was relatively higher than $10^3$ CFU/g prescribed by the International Microbiological Standard Recommended Limit [24]. The level in the control sample was below the TFC reported by Simi *et al.* [32] for starch powder. Also, the TFC of Turmeric sample was lower than that reported by Awoyale *et al*., [25] but higher than the TFC reported by

Simi *et al.* [32]. The higher TFC of pawpaw treated sample could be as a result of ill handling of the raw material. Bera *et al.* [33] reported that the growth of bacteria and fungi in the food sample is influenced by moisture content, high or low humidity, temperature of storage and type of sample.

## 5. CONCLUSION

The results have shown that custard made with turmeric had low sensory acceptability as compared to pawpaw-treated custard and the control. The panellists liked the pawpaw treated custard moderately but liked the control sample very much. Thus the pawpaw treated custard had good acceptance. Colour wise, both samples were moderately accepted and aroma wise the pawpaw treated sample was better as it was very much liked. The pawpaw treated sample had the highest values in almost all the proximate composition as compared to the control sample and the turmeric treated custard sample. It was also observed that the water absorption capacities of the control sample and pawpaw treated custard were closely related. Hence, it could be said that the pawpaw treated custard could be more acceptable commercially than the turmeric treated custard.

On the microbial basis, the result showed that pawpaw treated custard had acceptable level of *Streptococcus spp.* Also, the contamination limit in pawpaw treated custard, turmeric treated custard and the control were relatively higher than that recommended by the International Microbiology Standard limits for *Pseudomonas spp*, implying that the commercial custard product used as control in this study was below standard with regard to *Pseudomamonas spp*.

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