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PREVALENCE OF PATHOGENIC MICROORGANISMS IN THE ORAL CAVITY AND THEIR SENSITIVITY TO SOME SELECTED DENTIFRICE SOLD AT MAJOR MARKETS IN KANO METROPOLIS

***[1]Yahaya S. and [1]Ramatu, A. M.**
[1]Department of Microbiology, Faculty of Science, Bayero University, Kano.
*Corresponding author: syahaya.mcb@buk.edu.ng; sanishinkafi@gmail.com, Mobile: +234 (0) 806 516 8080

ABSTRACT
This study was conducted to determine the incidence of pathogenic microorganisms associated with dental caries and antimicrobial susceptibility test of some common dentifrice sold in Kano metropolis. A total of 50 samples were used in this study. The samples were taken using swab from human oral mucosa. The swabs were inoculated on chocolate agar, blood agar and MacConkey agar incubated at 37^{0}Cfor 24h, as well as Sabouraud's dextrose agar incubated at room temperature for 48h. Dentifrices were also analyzed for the fluoride, phosphate, nitrite, potassium, chloride, carbonate, sulphate, calcium, sodium, and zinc contents using C: Varian/Cary Winuv method, Acid Base Titration method, Gravimetry, and Air/Acetylene method. Of all the isolates, Streptococcus mutans was the most isolated pathogen with 24(30.38%), followed by Staphylococcus aureus with 23(29.11%), Candida. albicans 14(17.72%), Klebsiella specie 10(12.66%) and Escherichia coli 8(10.13%). Disc diffusion method with ten different dentifrices (code A-J) was tested for their antimicrobial activity against isolated oral pathogens. The samples were tested in triplicate, at full strength, 1:1, 1:2, 1:4, 1:8 and 1:16 dilutions. Inhibition zones were measured in millimeter after 24 hours. All the tested dentifrices demonstrated an antimicrobial activity. Dentifrice A showed the maximum mean zones of inhibition of 26.67, 24.00, 22.27, 19.67 and 18.67 against Klebsiella specie, Escherichia coli, Staphylococcus aureus, Streptococcus mutans and Candida albicans respectively, while dentifrice J showed the least activity of 0.00, 0.00, 0.00, 14.67 and 18.67 respectively against the same organisms. The concentrations of fluoride range between 8.3-132.3mg/L; phosphate, 45.8-191.8mg/L; nitrite, 11.0mg/L; potassium, 3.2mg/L; chloride, 5.1-5.6mg/L; carbonate, 8.2-12.8mg/L; sulphate, 0.3-0.9g; calcium, 14.7-16.1mg/L; sodium, 350.6-418.8mg/L and zinc, 6.2mg/L. In the present study, it has been demonstrated that triclosan-containing dentifrice are more effective in the control of pathogenic microorganisms associated with oral cavity compared to non-triclosan containing dentifrice.
Keywords: Bacteria, Dentifrice, Kano, Oral cavity.

INTRODUCTION

Dentifrice is a paste or gel used with a toothbrush as an accessory to clean and maintain the aesthetics and health of teeth. Dentifrice is used to promote oral hygiene, it serves as an abrasive that aids in removing the dental plaque and food from the teeth, assists in suppressing halitosis, and delivers active ingredients (most commonly fluoride) to help prevent tooth and gum disease called gingivitis (American Dental Association, 2010). A very significant proportion of dental problem are due to microbial infection. Dental problems are of three types, formation of dental plaque, dental caries and periodontal disease (Clarke, 1924). Plaque is a layer that forms on the surface of a tooth that has been linked to gingivitis, periodontal disease or dental caries (Jensena and Barkvoll, 1998). Periodontal diseases are bacterial infections that affect the supporting structure of the teeth (gingival, cementum, periodontal membrane and alveolar bone). Serious forms of periodontal disease that affect the periodontal membrane and alveolar bone may results in tooth loss. *Streptococci, Spirochetes* and *Bacteroides* are found to be the possible pathogens responsible for the disease (Manupati, 2010). Dental caries is a colonized, transmissible infectious process that ends up in the destruction of hard dental tissue. *Streptococcus mutans* is one of the main opportunistic pathogens of dental caries (Gamboa *et al.,* 2004). In addition, other microflora like *Escherichia coli* and *Candida albicans* are also associated with active caries lesion (Oztan *et al.,* 2006). Some constituents of tooth paste (fluoride, phosphate, nitrite, potassium, chlouride, sulphate, calcium, sodium, and magnesium) are of great importance in physiological functioning and development of human body. Such constituent may pass in to human body directly or indirectly during mouth washing. Since tooth paste are household essentials and many brand flood the market, their nature and form of usage is a subject of research interest (Oyewale, 2005). This study aimed to assess the prevalence of pathogenic microorganisms in the oral cavity and their sensitivity to some selected dentifrices sold at some major markets in Kano metropolis.

MATERIAL AND METHODS

Sample Collection and processing

Oral samples were collected after explaining the procedure to the consented persons. For each individual both sides of buccal mucosa were gently rubbed with a sterile cotton swab for 15seconds. The swab were properly labelled and transported in a safety box within 1hour to the laboratory for isolation.

Microbiological analyses

The specimens were inoculated onto Nutrient agar supplemented with 5% sheep blood when the agar base cooled to 56^0C (Chocolate agar) and 50^0C (Blood agar) for the isolation of *Streptococcus mutans* and *Staphylococcus aureus* respectively. The plates were then incubated at 37^0C for 24hour in candle jar. *S. mutans* and *S. aureus* colonies were chosen based on their morphology and further confirmation was done using biochemical tests such as Catalase and Coagulase test as described by Cheesbrough (2004) and optochin sensitive test (for *S. mutans*) by Patterson (1996). MacConkey agar was inoculated for the isolation of Gram negative bacteria and the plates were incubated at 37^0C for 24hour aerobically and further confirmed by urease test, sugar fermentation test, citrate utilization test and indole test (Cheesbrough, 2004). *Candida albicans* was isolated on Sabouraud's Dextrose agar at room temperature for 48hour and further confirmed by Germ tube test as described by Cheesbrough (2004).

Antimicrobial Assessment of the sampled Dentifrices

A total of ten (10) different types of dentifrice were used in this study. Dentifrice was prepared in sterile distilled water (1g/ml). Sterile filter disc were impregnated with the 50g of dentifrice as full strength and some sterile filter discs soaked in 1:1, 1:2, 1:4, 1:8 and 1:16 dilutions. Then the discs were dried in an oven at 60^0C for 2 hours (Sadeghi and Assar, 2009). Antimicrobial activities were determined by disc diffusion (Kirby-Baeur) method. Mueller Hinton agar was used to demonstrate the antimicrobial effect on *Escherichia coli*, *Klebsiella* spp. and *Staphylococcus aureus*, while Brain Heart Infusion agar was used for *Streptococcus mutans* and Sabouraud's Dextrose agar for *Candida albicans*. Afterwards, the plates were incubated at 37^0C for 24hours (48 hours for yeast).

Elemental Analysis of the dentifrices

In all the samples 10% solution of the dentifrice were used for the analysis. Concentration of fluoride, phosphate, nitrite, potassium, chloride, calcium, and sodium were determined using C: Varian/Cary Winuv method with Carry 50 instrument. Concentration of carbonate was determined using Acid Base Titration method, concentration of sulphate was determined using Gravimetric method with filter paper and concentration of zinc was determined using Air/Acetylene method with AAS Buck Scientific 210 VGP.

Statistical Analysis

Percentage was used for the number of isolates. The mean values of inhibitory zones for various dentifrices were analyzed by one-way analysis of variance (ANOVA) using Sigma Plot Statistical software. Values were considered significant when $p<0.05$.

RESULTS

Sixty five colonies of bacteria and fourteen of *C. albicans* were isolated from the fifty specimens analyzed in this work (Table 1). *S. mutans* had the highest frequency of 24 colonies (30.38%) while *E. coli* had the least frequency of 8 colonies (10.13%).

Table 1: Distribution of isolates and their percentages

Organisms	Frequency of Isolates	% Frequency
S. Mutans	24	30.38
S. aureus	23	29.11
K. specie	10	12.66
E. coli	8	10.13
C. albicans	14	17.72
TOTAL	**79**	**100**

Results for antimicrobial activity of the 10 dentifrice formulations against *S. aureus* indicated that dentifrice designated as 'A' produced the highest mean zone diameter of inhibition of 22.27±1.53mm using full strength and 11.33±2.08mm at 1:16 dilution. Dentifrice G, H, and J produced no zone diameter of inhibition at all the concentrations tested (Table 2). The antimicrobial activity exhibited by these dentifrices on *S. mutans* indicates that dentifrice A had the highest effect while dentifrice J had the least effect (Table 2). A mean diameter zone of inhibition of 19.67±1.53mm and 9.67±0.58mm were produced by full strength and 1:16 dilution formulation of A dentifrice (Table 3). All the 10 dentifrices were found to demonstrate zone diameter of inhibition at least using the 1:1 dilution. The results for antimicrobial activity of the 10 tested dentifrices against *Klebsiella.* species were shown in Table 4. Dentifrice formulation A had the maximum mean zone diameter of inhibition of 26.67±1.53mm and 14.33±1.15mm using full strength and 1:16 dilution. Only four dentifrices were found to produce antimicrobial activity against *Klebsiella.* species. Dentifrice E, F, G, H, I and J produced no zone diameter of inhibition at all the concentrations tested. Results for antimicrobial activity of the tested dentifrices formulations against *E. coli* were shown in Table 5. Dentifrice formulation A exhibited the highest mean zone diameter of inhibition of 24.00±1.00mm using full strength and 13.00±2.00mm using 1:16 dilution. While dentifrice I and J produced no zone diameter of inhibition at all the concentrations tested dentifrice. The antimicrobial activity exhibited by 10 dentifrices on *C. albicans* indicates that dentifrice formulation F had the highest mean zone diameter of inhibition of 22.00±1.73mm and 10.00±2.00mm were produced by full strength and 1:8 dilutions. Dentifrice formulation I had the least activity of zero zone diameter of inhibition at all the concentration.

Table 2: The Mean Diameter of Inhibition Zones (mm) of Anti-microbial Activity of Dentifrice Formulations against *Staphylococcus aureus*

Dentifrice Furmulation	FS	1:1 Dilution	1:2 Dilution	1:4 Dilution	1:8Dilution	1:16 Dilution
A	22.27±1.53	19.67±2.08	17.00±1.73	16.67±1.15	14.67±0.58	11.33±2.08
B	21.00±1.73	19.33±1.53	16.00±2.00	0.00±0.00	0.00±0.00	0.00±0.00
C	20.00±1.00	17.67±1.15	16.33±1.53	12.67±1.15	12.33±1.53	9.67±2.08
D	18.67±1.53	17.00±1.00	15.33±0.58	0.00±0.00	0.00±0.00	0.00±0.00
E	19.33±2.08	17.00±2.00	16.00±2.67	14.33±2.52	11.67±2.89	0.00±0.00
F	20.67±1.53	14.33±1.15	12.33±1.15	10.67±0.58	0.00±0.00	0.00±0.00
G	0.00±0.00	0.00±0.00	0.00±0.00	0.00±0.00	0.00±0.00	0.00±0.00
H	0.00±0.00	0.00±0.00	0.00±0.00	0.00±0.00	0.00±0.00	0.00±0.00
I	11.67±0.58	10.00±0.00	9 .67±1.15	8.00±1.00	0.00±.000	0.00±0.00
J	0.00±0.00	0.00±0.00	0.00±0.00	0.00±0.00	0.00±0.00	0.00±0.00
Control	0.00±0.00	0.00±0.00	0.00±0.00	0.00±0.00	0.00±0.00	0.00±0.00

FS: Full strength. No significant difference: (P = <0.001).
Control: Sterile filter disc.

Table 3: Table 3. The Mean Diameter of Inhibition Zones (mm) of Anti-microbil Activity of Dentifrice Formulations against *Streptococcus mutans*

Dentifrice Formulation	FS	1:1 Dilution	1:2 Dilution	1:4 Dilution	1:8 Dilution	1:16 Dilution
A	19.67±1.53	18.33±1.15	15.33±1.15	12.33±1.53	12.00±1.00	9.67±0.58
B	15.67±1.15	13.33±1.53	10.67±0.58	8.00±2.00	0.00±0.00	0.00±0.00
C	10.00±1.73	8.00±1.00	5.33±1.15	0.00±0.00	0.00±0.00	0.00±0.00
D	10.00±2.00	5.67±1.15	0.00±0.00	0.00±0.00	0.00±0.00	0.00±0.00
E	16.67±2.08	14.67±2.89	11.33±0.58	7.33±1.53	0.00±0.00	0.00±0.00
F	11.67±1.53	7.67±2.52	0.00±0.00	0.00±0.00	0.00±0.00	0.00±0.00
G	11.33±0.58	9.00±1.00	0.00±0.00	0.00±0.00	0.00±0.00	0.00±0.00
H	10.67±1.53	8.67±1.15	7.00±2.00	0.00±0.00	0.00±0.00	0.00±0.00
I	12.33±2.52	10.67±2.08	8.00±2.67	0.00±0.00	0.00±0.00	0.00±0.00
J	14.67±1.15	11.33±0.58	8.67±1.53	6.67±2.08	0.00±0.00	0.00±0.00
Control	0.00±0.00	0.00±0.00	0.00±0.00	0.00±0.00	0.00±0.00	0.00±0.00

FS: Full strength. No significant difference: (P = <0.001).
Control: Sterile filter disc.

Table 4: The Mean Diameter of Inhibition Zones (mm) of Anti-microbil Activity of Dentifrice Formulations against *Klebsiella* species

Dentifrice Formulation	FS	1:1 Dilution	1:2 Dilution	1:4 Dilution	1:8 Dilution	1:16 Dilution
A	26.67±1.53	24.33±0.58	22.00±1.00	20.00±0.00	18.00±1.00	14.33±1.15
B	17.00±1.73	14.00±1.00	11.33±1.15	7.67±0.58	6.33±1.15	0.00±0.00
C	17.33±1.73	14.33±0.58	12.00±1.00	9.67±0.58	8.33±1.15	6.33±1.15
D	16.67±0.58	14.00±1.00	10.67±1.53	9.33±1.15	6.67±0.58	0.00±0.00
E	0.00±0.00	0.00±0.00	0.00±0.00	0.00±0.00	0.00±0.00	0.00±0.00
F	0.00±0.00	0.00±0.00	0.00±0.00	0.00±0.00	0.00±0.00	0.00±0.00
G	0.00±0.00	0.00±0.00	0.00±0.00	0.00±0.00	0.00±0.00	0.00±0.00
H	0.00±0.00	0.00±0.00	0.00±0.00	0.00±0.00	0.00±0.00	0.00±0.00
I	0.00±0.00	0.00±0.00	0.00±0.00	0.00±0.00	0.00±0.00	0.00±0.00
J	0.00±0.00	0.00±0.00	0.00±0.00	0.00±0.00	0.00±0.00	0.00±0.00
Control	0.00±0.00	0.00±0.00	0.00±0.00	0.00±0.00	0.00±0.00	0.00±0.00

FS: Full strength. No significant difference: (P = <0.001).
Control: Sterile filter disc.

Table 5: The Mean Diameter of Inhibition Zones (mm) of Anti-microbil Activity of Dentifrice Formulations against *Escherichia coli*

Dentifrice Formulation	FS	1:1 Dilution	1:2 Dilution	1:4 Dilution	1:8 Dilution	1:16 Dilution
A	24.00±1.00	21.67±1.53	19.67±2.08	18.00±1.73	16.33±0.58	13.00±2.00
B	15.00±1.73	11.67±1.53	9.33±1.15	6.00±1.00	0.00±0.00	0.00±0.00
C	20.67±2.08	18.67±1.53	16.33±0.58	13.67±1.53	10.33±1.15	7.67±2.52
D	16.67±1.53	13.00±1.73	10.00±2.65	0.00±0.00	0.00±0.00	0.00±0.00
E	18.33±0.58	16.00±1.00	14.67±1.53	11.33±1.15	8.67±2.08	0.00±0.00
F	15.67±1,15	13.33±1.53	10,67±0.58	10.00±1.00	8.33.±0.58	5.33±1.53
G	19.33±1.53	16.00±2.00	13.67±2.08	13.00±100	9.33±0.58	0.00±0.00
H	11.67±2.08	8.67±1.15	6.33±0.58	0.00±0.00	0.00±0.00	0.00±0.00
I	0.00±0.00	0.00±0.00	0.00±0.00	0.00±0.00	0.00±0.00	0.00±0.00
J	0.00±0.00	0.00±0.00	0.00±0.00	0.00±0.00	0.00±0.00	0.00±0.00
Control	0.00±0.00	0.00±0.00	0.00±0.00	0.00±0.00	0.00±0.00	0.00±0.00

FS: Full strength. No significant difference: (P = < 0.001).
Control: Sterile filter disc.

Table 6. The Mean Diameter of Inhibition Zones (mm) of Anti-microbil Activity of Dentifrice Formulations against *Candida albicans*

Dentifrice Formulation	FS	1:1 Dilution	1:2 Dilution	1:4 Dilution	1:8Dilution	1:16 Dilution
A	18.67±0.58	16.33±1.15	14.00±1.00	12.00±1.73	9.33±1.15	0.00±0.00
B	19.00±1.00	16.67±1.15	13.33±2.08	12.00±1.73	11.67±0.58	9.67±1.53
C	16.33±1.53	0.00±0.00	0.00±0.00	0.00±0.00	0.00±0.00	0.00±0.00
D	21.33±1.15	19.00±1.00	17.00±1.73	15.33±1.53	9.67±0.58	0.00±0.00
E	21.33±1.53	17.67±0.58	15.00±100	13.67±1.53	10.00±2.00	0.00±0.00
F	22.00±1.73	19.67±1.53	18.00±1,00	13.67±1.53	10.00±2.00	0.00±0.00
G	18.00±0.00	14.00±100	10.33±0.58	0.00±0.00	0.00±0.00	0.00±0.00
H	18.67±1.15	16.67±0.58	14.00±1.00	11.67±1.53	9.33±2.08	0.00±0.00
I	0.00±0.00	0.00±0.00	0.00±0.00	0.00±0.00	0.00±0.00	0.00±0.00
J	18.67±0.58	12.33±2.08	0.00±0.00	0.00±0.00	0.00±0.00	0.00±0.00
Control	0.00±0.00	0.00±0.00	0.00±0.00	0.00±0.00	0.00±0.00	0.00±0.00

FS: Full strength. No significant difference: (P = 0.002).
Control: Sterile filter disc.

From the Table 7, it could be observed that fluoride concentration ranged between 5.1-132.4mg/l, dentifrice formulation I had the highest fluoride concentrations of 132.4mg/l and dentifrice formulation J had the least concentration of 5.1mg/l. Sodium concentration ranged between 350.6-420.7mg/l, dentifrice G had the highest concentration of 420.7mg/l while dentifrice formulation D had the least concentration of 350.6mg/l. The concentration of sulphate ranged between 0.3-0.9g, dentifrice formulation J had the highest concentration of 0.9g and formulation F had the least concentration of 0.3g. The concentration of phosphate ranged between 45.9-191.8mg/l dentifrices C had the highest concentration value of 191.8mg/l and dentifrice D had the least concentration value. Calcium and carbonate concentrations ranged between 14.7mg/l and 8.2mg/l – 16.1mg/l and 12.8mg/l respectively. Dentifrice D had the highest concentrations of 16.1mg/l and 12.8mg/l of calcium and carbonate while dentifrice I had the least of 14.7mg/l and 8.2mg/l of calcium and carbonate respectively. Chloride present in formulation E and J had the concentration of 5.6mg/l and 5.1mg/l respectively. Potassium and nitrate are present in formulation A only. Potassium had the concentration of 3.2mg/l and nitrate had 11.0mg/l concentration. And zinc was present only in formulation B with concentration of 6.2mg/l.

Table 7 Elemental Composition of the Various Brands of Dentifrices Used in the Study (mg/L or g)

Dentifrice	Fluoride	Sodium	Sulphate	Phosphate	Calcium	Carbonate	Chloride	Potassium	Nitrite	Zinc
A	119.3	409.1	NF	NF	NF	NF	NF	3.2	11	NF
B	111.4	416.5	0.6	NF	NF	NF	NF	NF	NF	6.2
C	115.4	406.5	0.7	191.8	NF	NF	NF	NF	NF	NF
D	105.9	350.6	0.4	45.9	16.1	12.8	NF	NF	NF	NF
E	8.3	418.2	0.8	NF	NF	NF	5.6	NF	NF	NF
F	121.1	360.2	0.3	NF	14.8	8.8	NF	NF	NF	NF
G	111.4	420.7	0.8	178.5	NF	NF	NF	NF	NF	NF
H	99.6	378.9	0.5	87.9	NF	NF	NF	NF	NF	NF
I	104.7	372.6	NF	109.4	14.7	8.2	NF	NF	NF	NF
J	132.3	418.8	0.9	88.3	NF	NF	5.1	NF	NF	NF

NF: NOT FOUND

DISCUSSION

The microorganisms isolated from the oral mucosa with no clinical features of dental caries were *S. mutans, S. aureus, E. coli, K.* specie *and C. albicans*. This agrees with the research work conducted by Chinenye and Emeka (2001) on antimicrobial properties of *Terminalca glaucescens* and *Zanthoylum zanthoxyloides* extract and spectrum of their activity. The present study demonstrates that the *S. mutans* among the isolated organisms in oral mucosa was found to be 30.38% which is similar to the result obtained from other studies. This agree with result obtained by Maripandi *et al*. (2011) on Prevalence of dental caries bacterial pathogens and evaluation of inhibitory concentration effect on different tooth pastes against *Streptococcus* spp. This is because of there is extensive evidence associated *S. mutans* with dental caries. It has been suggested that oral cavity may also constitute an addional and possibly more stable reservoir of respiratory pathogens (Sumi *et al*., 2006). *S. aureus* was the second most occurrence isolates with 29.11% this agrees with the work of Daniluk *et al*. (2006) on aerobic bacteria in the oral cavity with *S. aureus* having 30.0%. *Klebsiella* specie and *E.coli* was relatively lower 12.66% and 10. 13% compared with gram positive pathogens. The reason of this was very possible because Gram positive pathogens are dominant in human oral cavity. From this study *C. albicans* was found to be 17.77% and this agrees with the study on prevalence of dental caries bacterial pathogens by Maripandi *et al*. (2011). However, slight modification of the host defense system, or host ecological environment, can assist the transformation of *C. albicans* into a pathogen capable of causing infections that may be lethal.

Dentifrice A was observed to be the most effective, based on the mean diameter of the zone of produced by the dentifrice in agar disc diffusion method, against almost all the tested microorganisms. This is due to the presence of triclosan in its formulation. Manupati (2011), also showed similar result with this research as triclosan containing dentifrice are the most effective against his tested organisms. Many studies using triclosan as an anti plaque agent were carried out and have given good result (Kjaerheim and Waaler, 1994). Dentifrice formulations B, C and D are fluorinated products. Among the dentifrices, formulations E, F and G were obtained to be moderately effective and contain active ingredients as sodium mono fluoride, sodium fluoride and sodium lauryl sulfate products. This agrees with Manupati, (2011) where he reported antimicrobial efficacy of different toothpaste and mouth rinse. Dentifrice formulations H, I and J are the least effective dentifrice as shown from the zone of inhibition measured. This is due to the presentence of potassium nitrate and sodium fluoride as active ingredient in their formulation and they lack antimicrobial activity (Kamal *et al*., 2010), where as formulation J exhibited activity on only two tested microorganisms and is also a fluorinated product, but this could be due to the fact that effectiveness of fluoride toothpaste is concentration dependent (Fejerskov and Kidd, 2003). In the present study, the herbal formulations D and G appeared to be equally effective as the fluoride formulations. This agrees with the work of Amrutesh *et al,* 2010 on Clinical Evaluation of a Novel Herbal Dental Cream.

The activity, potency, and commercial acceptability of dentifrice are associated with the fluoride and phosphate levels (Borissova, *et al.,* 1993). Fluoride is widely known to prevent tooth decay and many dental diseases, and phosphate believed to give strong teeth because of its known association with bone formation and sustenance (Jiz *et al*., 1996). The fluoride level in the dentifrice is within 8.3 - 132.3mg/L (Table 7). The phosphate level is present in samples B, D, G, H, I, and J where sample C have the highest level of phosphate 191.81mg/L. This agrees with the study of Oyewale (2005) on estimation of essential inorganic constituents in commercial toothpaste. The dentifrice with high level of phosphate will be beneficial to users who are deficient in phosphorous especially at early stages of bone development (Oyewale, 2005).

Dentifrices D, F, and I has calcium carbonate, bone and teeth are of essentially made up calcium, the main of abrasion agent in most toothpastes is calcium carbonate this also agrees with Oyewale (2005). Dentifrice D has the highest calcium, and also has phosphate a combination that could be useful for people prone to osteoporosis, a bone disorder associated with deficiency in these elements (Oyewale, 2005). The elements sodium and potassium which are present in formulation A, and sodium in all the formulations, with no significant role in toothpaste formulation and tooth care, are introduced into toothpastes as vehicles for incorporating fluoride, phosphate and other additives (Oyewale, 2005). Nitrate is present only in formulation A as potassium nitrate, Pereira and Chava (2001) revealed that 3% potassium nitrate appears to have therapeutic potential to alleviate dental hypersensitivity. Zinc and sulphate are present in formulation B in form of zinc sulfate, Navada and Kumari (2008), proved that a significant improvement in oral malodor was achieved with toothpaste containing 0.2% zinc sulphate after a single brushing.

Conclusion

Based on the result of this work *S. mutans* had highest frequency of 30.38% among pathogenic microorganisms associated with dental cavity. *E. coli* on the other hand had the least percentage of 10.13%. The work revealed that dentifrices containing triclosan were more effective in inhibiting the growth of these microorganisms, compared to dentifrice containing sodium fluoride and plant extracts even on *Klebsiella* spp. which exhibited high resistance to most tested dentifrices. This suggests that the use of dentifrice made of triclosan will go a long way in controlling cases of oral contaminants.

Recommendations

On the basis of aforementioned, the following recommendations are imperative:

1. Dentifrice with antimicrobial active ingredients (Triclosan) should be used because it showed antimicrobial effectiveness in many researches including present study.
2. At least tooth brush with dentifrice twice in a day is recommended in order to reduce microbial accumulation in buccal cavity.

Contribution of Authors

This work was a collaboration effort between the authors. Author Yahaya, S. designed the study and properly organized the manuscript. Author Ramatu, A.M. managed and handled all the experimental processes. All authors read to their satisfaction and approved the final manuscript.

Conflict of Interest

There was no any complicit of interest between the authors.

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