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COMPARISON OF THE ACTIVE INGREDIENTS IN TWO COMMERCIAL TOOTHPASTE (CLOSE-UP AND COLGATE) AND DENTAL POWDER (DR. AGNES NWAMMA)

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ABSTRACT

The active ingredients in two commercial toothpaste (close-up and colgate) and dental powder (Dr. Agnes Nwamma) were analyzed and compared. Proximate analysis showed that close-up has a higher fluoride content (13.35 mg/l) than Colgate (11.98 mg/l) and Dr. Agnes Nwamma (11.30 mg/l). Moisture content (4.99%) and pH value (7.2) are higher in Colgate than Close –up and Agnes Nwamma while phosphate content (2.46 mg/l) is higher in Dr. Agnes Nwamma than the commercial toothpastes. This indicates that the active ingredient in toothpaste and Dental powder is fluoride. The label contents showed higher than the actual contents in Close-up, Colgate and Agnes Nwamma. Other minerals such as calcium, potassium, magnesium and sodium were tested for and the result showed that Close-up has no magnesium content.

Keywords: Active Ingredients, Cavity, Plaque, Remineralization, Teeth Whitening.

1. INTRODUCTION

Our modern oral hygiene with tooth paste, toothbrush and floss began only in the 1950's while the quest for a clean mouth dates back to at least 5000 years. Dental paste used by ancient Egyptians was made of oxen hooves, myrrh, eggshells and pumice. The ancient Romans and Greeks allegedly used crushed bones and oyster shell. Europeans experimented with table salt, burnt ashes and charcoal. Some used burnt bread among the ingredients or dragon's blood, a natural dark red plant resin (Arkansas, 2019).

In 1824, a dentist named Pea Body was the first person to add soap to dental paste, followed by John Haries in the 1850's who added chalk as an ingredient. About 20 years later, Colgate mass produced the first tooth paste jar. In 1892, Dr. Washington Sherfield made the first tooth paste that came from a collapsible tube. Fluoride was first added to tooth paste in 1914. More improvements continued after the World War II (Arkansas, 2019) that saw the advancement in synthetic detergent which allowed producers of tooth paste to replace soap with emulsifying agents and introduce whitening agents in toothpaste.

Today's toothpaste and dental powder share many of the same ingredients. The health effect of tooth paste and dental powder include effective removal of plague, removal of stain and elimination of bad breath. Modern tooth paste contain ingredients that help strengthen the teeth enamel and protect against dental problems like tooth sensitivity, tooth discolouration, tooth decay and gum disease (Altima, 2019).

Active ingredients in tooth paste and dental powder are the components of the tooth paste/dental powder that make it effective. These are the ingredients that stop the paste from drying out, keep it at good pH, stop microbial growth, make it thick enough for use, including the foaming and flavouring agents.

Tooth paste is a gel-like dentifrice used with a tooth brush to clean and maintain the aesthetics and health of the teeth. Tooth paste assists in suppressing halitosis and delivers active ingredients (commonly fluoride) to help prevent tooth decay and gum disease (gingivitis).(Ada 2010).Sodium fluoride (NaF)is the most common source of fluoride, although stannous fluoride (SnF) and sodium monofluorophosphate (Na_2PO_3F) may also be used (Aspinall, 2021).

Dental powder is a mixture of ingredients that act as an alternative to tooth paste as a cleaning agent. Dental powders are made with all natural and often organic ingredients. They are free from potentially harmful chemicals, artificial flavours and colours. Unlike tooth paste, dental powder requires wetting the tooth brush before spraying the dental powder to make it stay on the tooth brush (Christine 2020).

Regardless of what brand of tooth paste, there are some ingredients that are standard in all non-organic brands. They include:

Binders:-These thicken the tooth paste. They prevent separation of solid from the liquid components especially during storage. They affect the rinsing of the toothpaste from the tooth brush. Examples include bentonte, methylcellose, magnesium aluminium silicates, karaya gum e.t.c.

Abrasives:-They gently scrub, polish and clean bacteria from the teeth and gum. They are responsible for dissolving stains from the teeth. Common abrasives include hydrate silica, calcium carbonate, calcium sulphate, sodium bicarbonate, tricalcium phosphate, sodium meta – phosphate hydrated alumina e.t.c.

Sudsers:- These are known as surfactants. They lower the surface tension of water so that bubbles are formed. Multiple bubbles together create foamy texture associated with tooth paste. They help to dislodge particles and remains of food from the teeth. Common sudsers include sodium lauryl sulphate, sodium stearyl funmarate, and sodium stearyl lactate.

Humectants:- These help to retain water in the toothpaste. Humectants keep the solid and liquid phase together. They can also add coolness and /or sweetness to the tooth paste making the tooth paste feel pleasant in the mouth. Common humectants include sorbitol or glycerin. Propylene glycol can also be used.

Flavouring agent:- Tooth pastes have flavours that make them palatable. Common flavours include mint, spearmint, peppermint, wintergreen and cinnamon. Exotic flavours include bourbon, rye, anise, clove, caraway, coriander, cucalyptuse, nutmeg and thyme. In addition to flavours, tooth pastes contain sweetness. Examples include saccharine and aspartaine.

Fluorides:- Fluorides reduce decay by increasing the strength of the teeth. Sodium fluoride is the most commonly used fluoride. Sodium perborate is used as a tooth whitening ingredient. Most tooth paste contains preservatives. Fluoride promotes remineralization of the teeth but is limited by bio available calcium (Shen, 2018).

Water is also used for dilution purpose (Annette, 2015).

Basic contents of dental powder include:-

Sodium bicarbonate:-Sodium bicarbonate is a white solid that is crystalline but appears as fine powder. Baking soda has natural whitening properties which is why it is a popular ingredient in commercial dental powder. It is a mild abrasive that can help scrub surface stain from teeth. Bakingsoda creates an alkaline environment in the mouth which prevents bacteria from growing.

Cloves:-Cloves contain a strong an anesthetic which also work as antiseptic to fight bacteria that may cause infection. That is why cloves are effective in fighting cavities.

Cinnamon:-Cinnamon extracts and their compounds may help prevent cavities, treat gum disease, fight fungal and bacterial infections.

Coarse salt:-Coarse salt refers to sea salt or kosher salt that has particle size much larger than the table salt. As salt is mildly abrasive, it swiftly removes plaque and other remnants from the teeth. Coarse salt has antibacterial properties.

Artificial sweeteners:-Unlike regular sugar, artificial sweeteners are considered non-cariogenic, meaning that they do not contribute to tooth decay (Christine, 2020).

Fluoride:-Some commercial dental powders contain fluoride. Common source of fluoride is sodium fluoride (NaF). Stannous fluoride may also be used.

Specification for Dr Agnes Nwamma dental powder includes

- **i.** 100% natural
- **ii.** No side effect and safe for all.
- **iii.** Can be used by children
- **iv.** Accelerate tooth hole filling
- **v.** Fight germs from the root of the teeth

vi. Healing of tooth ache.

2.0 METHODOLOGY

Two commercial toothpastes (closeup and colgate) and a dental powder (Dr Agnes Nwamma) were purchased at a supermarket at Oko, Orumba North Local Government Area. Similar tests were carried out on the samples and the active ingredients in the samples were compared.

Test for Fluoride

5g of the sample was dissolved with aqua-Regia**.** It was then made up to 50ml with distilled water. 1ml of complex solution (0.5M of Ethanol and 0.5M of aluminum ion solution in ratio 1:2) was added. It was left to stand for 5 minutes for colour development. It was read in the UV at 624 nm using a 2M of Fluorine solution as standard.

i. Test for pH

pH was measured by electrometric method using laboratory pH meter (Hanna model HI991300 (APHA:1998).

The electrode was rinsed with distilled water and blot dry. The pH electrode was then rinsed in a small beaker with a portion of the sample. Sufficient amount of the sample was poured into a small beaker to allow the tips of the electrode to be immersed to a depth of about 2cm. The electrode was at least 1cm away from the sides and bottom of the beaker. The temperature adjustment dial was adjusted accordingly. The pH meter was turned on and the pH reading recorded.

ii. Test for moisture content

A petri-dish was washed and dried in the oven. Exactly 2g of the sample was weighed in the petri-dish. The weight of the petri-dish and sample was noted before drying. The petri-dish and sample were put in the oven for another 30-minutes and the weight was noted. The drying procedure was continued until a constant weight was obtained.

Moisture content is measured as weight of petri-dish and sample before drying minus weight of petri-dish after drying divided by weight of the sample and then multiplied by one hundred per cent.

iii. Test for phosphate

Phosphate was measured using standard method. 100ml of the homogenized and filtered sample was drawn by pipette into another conical flask. Iml of $18MH_2SO_4$ and 0.89g of ammonia per sulphate were added to both conical flasks and gently boiled for one and half hours keeping the volume of $25.50cm^3$ with distilled water. It was then cooled. One drop of phenolphthalein indicator was added and neutralized to a pink colour with the 2M NaOH solution. The pink colour was discharged by dropwise addition of 2M HCl and the solution was made up to 100ml with distilled water. For the colorimetric analysis, 20ml of the sample was drawn by pipette into test tubes. 10ml of the combined reagent was added, shaken and left to stand for 10 minutes. Afterwards the absorbance was read at 690nm on a spectrophotometer, using 20ml of distilled water plus 1ml of the reagent as reference.

3.0 RESULTS AND DISCUSSION

The result of the fluoride content in two commercial tooth pastes and dental powder is presented in table 1

Table 1:-Composition of fluoride in tooth paste and dental powder.

Samples	Actual composition of fluoride (mg/l)	Label composition of fluoride (mg/l)	Difference in fluoride composition (mg/l).
Close-up	13.35	14.00	0.65
Colgate	11.98	12.78	0.80
Agnes Nwamma	11.31	11.50	0.20

From the table 1, it can be seen that the fluoride concentration in Close-up is higher, followed by Colgate and Dr Agnes Nwamma. The labeled composition of fluoride in the samples under investigation is higher by the following differences; Close-up (0.65), Colgate (0.80), and Agnes Nwamma (0.2) respectively. The specified fluoride contents on the toothpaste labels were higher than the actual contents. Although there were expectations, the fluoride content in the close-up toothpaste (13.353) is higher than the report of the other toothpaste. Agnes Nwamma (11.309) is lower compared to the work of Yildiz, whose work was reported as (17. 6). The Colgate toothpaste (11.954) also had a lower fluoride content compared to the work Yildiz (14.00). The report for Close-up (13.353) compares favourably with the report of Yildiz (2018).This makes close-up better toothpaste, if fluoride content is to be considered alone. The choice of toothpaste depends on individuals' need. While fluoride is good for fighting cavities and making strong teeth, tooth paste with fluoride arising from stannous fluoride is better in fighting gingivitis and dental erosion but may cause teeth staining over period of use. NAFDAC recommends fluoride content range of (850-1500) ppm.

The result of the mineral content in two commercial tooth paste and dental powder is presented in the table 2 below.

Table 2:-Mineral content in two commercial tooth paste and dental powder(ppm)

Parameters	Actual Mineral Content			Label Mineral Content			Difference in Content		
	Close up	Colgate	Agnes	Close up	Colgate	Agnes	Close up	Colgate	Agnes
Magnesuim	0.00	1.53	1.23	0.00	1.5	1.34	0.00	0.30	0.10
Sodium	4.26	3.79	4.75	450	4.50	5.00	0.24	0.71	0.25
Potassium	0.13	0.19	0.25	0.15	0.20	0.57	0.01	0.00	0.31
Calcium	0.16	0.65	0.34	0.25	0.70	0.35	0.08	0.12	0.00

From Table 2, it can be seen that the labeled mineral contents are higher than the actual content of the toothpaste and dental powder. Dr Agnes Nwamma dental powder has the highest

mineral concentration of Magnesium, Sodium and Potassium followed by Colgate which has highest concentration of calcium. Close-up has no magnesium content. The presence of minerals (Calcium, Sodium, Potassium, Phosphate) are asserted for fighting against cavities and demineralization. Potassium helps to reduce tooth sensitivity. Calcium carbonate is one of the several abrasive agents that help to clean teeth, remove stains and plaques. Magnesium helps to maintain strong enamels.

Table 3: Moisture content (%)

Sample	Wt. of dish	Wt. of sample	Wt. of sample before heating	Wt. of after heating	% moisture
Close up	36.1	2.04	38.18	38.11	3.18
Colgate	34.6	2.04	36.12	36.02	4.99
Dr Agnes Nwamma	36.3	2.01	38.35	38.34	0.34

From Table 3, it can be seen that Colgate (4.99) has higher percentage moisture content than Close-up (3.180), then followed by Agnes Nwamma dental powder (0.34). This suggests why Colgate foams better than other toothpastes that were investigated.

The result of the pH in two commercial tooth paste and dental powder is presented in table 4.

Table 4:- pH range in two commercial tooth paste and dental powder.

	Sample	Actual pH	Label pH	Difference in pH	Standard pH by W.H.O
1.	Close- up	6.2	7.9	0.7	7.80 – 10.09
2.	Colgate	7.2	7.4	0.3	7.00 – 10.00
3.	Dr Agnes Nwamma	6.7	7.0	0.3	5.03 – 11.13

From table 4, it can be seen that Close-up is more acidic, followed by Dr Agnes Nwamma while Colgate has alkaline pH of 7.2.The label pH is higher than the actual pH in the samples. This shows that Colgate with a higher pH is better in the remineralization of the teeth. The result of the pH of the toothpastes and dental powder shows that Colgate has a higher pH range compared to other products and could be more effective in protecting the teeth from bacteria causing cavity. The NAFDAC recommended pH for toothpastes range is 6.5 to 7.5. According to Carifree (2016) high pH in toothpaste or dental powder can be used as therapy in different ways for people experiencing tooth decay. Lower pH can cause the teeth to demineralize or dissolve (Carifree 2016).

The result of phosphate in two commercial toothpaste and dental powder is presented in table 5 below

Table 5: Content of phosphate in toothpaste and dental powder

	Samples	Actual composition (mg/l)	Label composition (mg/l)	Difference in the content result
1.	Close up	2.05	2.20	0.15
2.	Colgate	2.44	2.50	0.06
3.	Dr Agnes Nwamma	2.47	2.45	0.02

From table 5 above, the labeled content is higher than the actual content with the following differences; Dr Agnes Nwamma (0.02), Close-up (0.15) Colgate (0.06). Dr Agnes Nwamma has the highest phosphate content than Colgate and Close-up toothpaste. The result of the composition of phosphate shows that sample match closely with their specified label phosphate content. The presence of phosphate in toothpaste and dental powder according to Gemma (2021) prevent and repair damage to the tooth surface. It is beneficial in remineralizing the teeth. Phosphorus along with fluoride and calcium are included in toothpaste because they play a key role in keeping the teeth from becoming soft and yucky which makes it easy for cavity to form.

4.0 CONCLUSION AND RECOMMENDATIONS

This study suggests that the most important ingredients of toothpaste are abrasives, water and fluoride. Abrasives such as calcium carbonate and calcium hydrogen phosphates help remove dirt on teeth and also help to polish them. Fluoride is the most active ingredient used to prevent decay of the teeth. Before buying toothpaste, care must be taken to check and make sure that the toothpaste contains fluoride.

Future research should be carried out on other brands of tooth paste and dental powder to know the percentage fluoride content and minerals present in them.

The use of tooth pastes, and dental powder with high pH and fluoride content should be encouraged by the dentists.

Finally, the findings of this investigation would guide consumers on the product best for their oral health.

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