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Fluoride concentrations and labeling information on adult toothpastes from Nigeria and the United Kingdom

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Abstract

Objectives: To determine fluoride concentrations and labeling information on adult toothpastes from Nigeria and the UK.

Methods: Ten popular, unexpired, locally made and commercially available sodium-monofluorophosphate and sodium fluoride adult toothpastes from Nigeria and the UK were randomly selected from the open markets. These toothpastes were the trademarked and conventional. The following information stated on toothpaste labels were recorded: active ingredient, concentration of active ingredient, direction for use, response to allergic reaction, storage temperature and instructions for children use. Triplicate samples from the top, middle and bottom of each toothpaste tube were taken and analysed for fluoride.

Results: The coefficient of variation in all the 4 Na_2FPO_3 toothpaste samples was less than 10% while it was greater than 10% but not more than 20% in 14 NaF toothpaste samples. Four made-in-Nigeria toothpastes had fluoride concentrations below 1000 ppm while none of the made-in-UK toothpaste had fluoride concentration less than 1000 ppm. No made-in-Nigeria toothpaste label stated that they contain both NaF and Na_2FPO_3 while it was written on 3 made-in-UK toothpaste labels. Fluoride concentrations were not stated on the labels of 4 made-in-Nigeria toothpastes. Two made-in-Nigeria toothpastes had different active ingredients after fluoride analysis when compared to the active ingredients stated on their labels. The active ingredients and their concentrations were stated on all made-in-UK toothpaste labels and the same ingredients were found after fluoride analysis. Only 1 (10.0%) of the made-in-Nigeria toothpaste label had information on how teeth should be cleaned and number of times it should be done while 9 (90.0%) of the UK toothpastes had this information. Only 1 (10.0%) UK toothpaste and none of the Nigerian toothpastes had information about when there is allergy to ingredients, don't use consult dentist or doctor, storing toothpaste below 25°C, not using toothpaste after expiration, keeping toothpaste away from children, flossing regularly and rinsing with mouthwash. The majority 9 (90.0%) of the toothpastes from the UK had instructions about children appropriate use of toothpaste while 2 (20.0%) Nigerian toothpastes had this information.

Conclusion: Toothpastes from the UK had appropriate active ingredients, more adequate concentration of fluoride and labeling information as compared to those from Nigeria.

Keywords: *Fluoride, Labeling, Adult, Toothpaste, Nigeria, United Kingdom*

Résumé

Objectifs: Déterminer les concentrations de fluorure et les informations d'étiquetage sur les dentifrices pour adultes du Nigéria et du Royaume-Uni.

Méthodes: Dix dentifrices pour adultes populaires, non périmés, fabriqués localement et disponibles dans le commerce, au monofluorophosphate de sodium et au fluorure de sodium, provenant du Nigéria et du Royaume-Uni ont été sélectionnés au hasard sur les marchés ouverts. Ces dentifrices étaient des marques déposées et conventionnelles. Les informations suivantes figurant sur les étiquettes des dentifrices ont été enregistrées: ingrédient actif, concentration de l'ingrédient actif, mode d'emploi, réponse à une réaction allergique, température de stockage et mode d'emploi pour les enfants. Des échantillons en triple du haut, du milieu et du bas de chaque tube de dentifrice ont été prélevés et analysés pour le fluorure.

Résultats: Le coefficient de variation dans tous les 4 échantillons de dentifrice Na2FPO3 était inférieur à 10% alors qu'il était supérieur à 10% mais pas plus de 20% dans 14 échantillons de dentifrice NaF. Quatre dentifrices fabriqués au Nigéria avaient des concentrations de fluorure inférieures à 1000 ppm, tandis qu'aucun des dentifrices fabriqués au Royaume-Uni n'avait une concentration de fluorure inférieure à 1000 ppm. Aucune étiquette de dentifrice fabriquée au Nigéria n'indiquait qu'elle contenait à la fois du NaF et du Na2FPO3 alors qu'elle était écrite sur 3 étiquettes de dentifrice fabriquées au Royaume-Uni. Les concentrations de fluorure n'étaient pas indiquées sur les étiquettes de 4 dentifrices fabriqués au Nigéria. Deux dentifrices

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fabriqués au Nigéria avaient des ingrédients actifs différents après l'analyse du fluorure par rapport aux ingrédients actifs indiqués sur leurs étiquettes. Les ingrédients actifs et leurs concentrations ont été indiqués sur toutes les étiquettes de dentifrice fabriquées au Royaume-Uni et les mêmes ingrédients ont été trouvés après l'analyse du fluorure. Seulement 1 (10,0%) de l'étiquette du dentifrice fabriqué au Nigéria contenait des informations sur la façon dont les dents devraient être nettoyées et le nombre de fois où cela devrait être fait, tandis que 9 (90,0%) des dentifrices britanniques avaient cette information. Seulement 1 dentifrice britannique (10,0%) et aucun des dentifrices nigérians n'avait d'informations sur les allergies aux ingrédients, ne pas utiliser, consulter un dentiste ou un médecin, stocker le dentifrice à une température inférieure à 25 ° C, ne pas utiliser de dentifrice après l'expiration, garder le dentifrice hors de la portée des enfants, passer régulièrement la soie dentaire et se rincer avec un bain de bouche. La majorité 9 (90,0%) des dentifrices du Royaume-Uni avaient des instructions sur l'utilisation appropriée du dentifrice par les enfants, tandis que 2 (20,0%) dentifrices nigérians avaient cette information.
Conclusion: les dentifrices du Royaume-Uni contenaient des ingrédients actifs appropriés, une concentration de fluorure plus adéquate et des informations d'étiquetage par rapport à ceux du Nigéria.

Mots clés*: Fluorure, Étiquetage, Adulte, Dentifrice, Nigéria, Royaume-Uni*

Introduction

Fluoride has been reported in many studies [1-3] to prevent the occurrence and progression of dental caries especially through its topical action in the mouth as it reaches the surface of the tooth, the plaque and the subsurface lesions. There are several sources of fluoride but toothpaste is the most widely used fluoride vehicle [4]. Fluoride is now recognized as the main factor responsible for the dramatic decline in caries prevalence observed worldwide [1,4]. Several studies have reported fluoride toothpastes as the main contributor to the total fluoride intake of young children [5,6]. Seppa [7] mentioned that the importance of fluoride toothpastes as a cost-effective and feasible method of fluoride delivery is indisputable and will be so in all countries irrespective of the caries level and oral health care delivery systems. Martens and Verbeeck [8] stated that the most effective caries preventive fluoride regimen is the daily low concentration application of fluoride from toothpastes. This is because it keeps low level of fluoride constantly present in the oral cavity where it is available for remineralization of early carious lesions. Many studies [9-12] have reported caries reduction among children when fluoride toothpastes were used. There is evidence that fluoride toothpaste will prevent and remineralize root caries in older adults especially when used with Acidulated Phosphate Fluoride [13-15].

In 2002, the WHO Collaborating center in Nijmengen, the Netherlands included Affordable Fluoride Toothpaste in its evidence-based Basic Package for Oral Care as a tool that will improve the oral health of the majority of the populace especially in developing countries and adequate amount of fluoride was highlighted in this package [16]. Some reports [17-19] have stated that excessive consumption of fluoride especially from toothpaste during tooth forming periods in young children may result in dental fluorosis. The prevalence and severity of dental fluorosis is dependent on the phase of mineralization of tooth enamel when excessive exposure to fluoride occurs, the amount of fluoride and the duration of fluoride exposure and body weight [20]. Therefore, effective use of fluoride, noted as one of the priority action areas in the World Health Organization Global Oral Health Programme policy [21] is important. Optimum levels of fluoride that are compatible with dental and general health should be used for toothbrushing especially in young children. Excess fluoride ingestion from swallowing too much toothpaste unintentionally during toothbrushing is of particular concern in children younger than 6 years of age because the crowns of the permanent teeth are undergoing calcification and are, therefore, susceptible to the uptake of fluoride into enamel apatite which, if excessive, can result in dental fluorosis [22,23].

Numerous studies [24-27] have reported various concentrations of fluoride in toothpastes, to range from 440 – 2800 ppm. Some studies [26,27] reported that the cariostatic effect of toothpaste is proportional to its fluoride concentration; therefore, those with 1500 mg F/g are more effective than those with lower concentrations. Twetman *et al.* [28] in their systematic review of caries preventive effect of fluoride toothpaste reported that toothpaste must contain fluoride concentrations of 1000 – 1500 ppm to be effective in preventing dental caries. In most developing countries, unpublished reports have shown that there is ineffective regulation on the amount of fluoride in toothpastes and children tend to use adult toothpastes probably due to non-availability and ignorance to the use of children toothpastes. These reports mentioned that many toothpaste manufacturing companies provide wrong information about the fluoride concentration of their products on their labels and these do not correspond with the fluoride level in the toothpaste. Van Loveren *et al*. [29] in their study on total and free fluoride toothpastes from some non-established market economy countries reported that not all toothpastes

contained fluoride in adequate concentrations that they claimed to contain. Anecdotally, reports have shown that some of Nigerian toothpastes' manufacturers do not provide information on good oral health care practices and appropriate use of fluoride toothpaste especially in children on their labels. This may have a negative impact on the oral health of the public. A previous study on fluoride contents of some Nigerian dentifrices reported that 30% of the dentifrices did not contain the percentage or concentration of fluoride as claimed by the manufacturer [30]. However, this Nigerian study did not make any comparison with toothpastes made in the UK and did not report labeling information. Therefore, this study sought to determine fluoride concentrations and labeling information on adult toothpastes from Nigeria and the United Kingdom.

Materials and methods

Ten popular, unexpired, locally and commercially available sodium fluoride (NaF) and sodium-monofluorophosphate (Na_2FPO_3) adult toothpastes from Nigeria and the UK were randomly selected from a list of all toothpastes in the open markets. These toothpastes were also the trademarked, conventional and were less than six months duration from time of manufacture. The randomly selected toothpastes were purchased from shops. The following information stated on toothpaste labels were recorded: active ingredient, concentration of active ingredient, direction for use and instructions for children use. Toothpastes from Nigeria were labeled 1 to 10 while those from the UK were labeled 11 to 20. The fluoride concentrations of NaF toothpaste samples were measured in triplicate at room temperature by a direct method using a fluoride ion-selective electrode (F-ISE) and meter (ISE, 720A Series; Orion Research Inc; Boston, MA, USA) after adding Total Ionic Strength Adjusted Buffer (TISAB) III based on the procedure by Duckworth et al. [31]. Samples of toothpastes labeled as containing Na_2FPO_3 were pretreated with 5 units ml-1 of acid phosphatase (P1146, 50 UN; Sigma-Aldrich, St Louis, MO, USA) and incubated at 37°C for 3 hours before their fluoride concentrations were measured [32].

Validation of the measurement method was carried out by analysing standard fluoride solutions of 0.1 ppm, 1.0 ppm and 10.0 ppm.

Table 1: Distribution of fluoride concentration in adult toothpastes

Adult toothpaste samples	Fluoride concentration (ppm)								Coefficient of variation (%)	
	(Top)		(Middle)		(Bottom)		(Mean ±SD)			
	Na_2FPO_3	NaF	Na_2FPO_3	NaF	Na_2FPO_3	NaF	Na_2FPO_3	NaF	Na_2FPO_3	NaF
Nigeria										
1	211	190	235	128	222	150	222.7±12.0	156.0±31.40	4	20
2	0	1027	0	986	0	1228	0	1080.3±129.5	-	12
3	0	1006	0	1018	0	1144	0	1056.0±76.4	-	7
4	0	1036	0	897	0	1174	0	1035.7±138.5	-	13
5	0	36	0	41	0	53	0	43.3±8.7	-	20
6	0	1229	0	1248	0	1303	0	1260.0±38.4	-	3
7	0	28	0	31	0	29	0	29.3±1.5	-	5
8	0	17	0	16	0	23	0	18.7±3.9	-	20
9	0	1451	0	1425	0	1455	0	1443.7±16.3	-	1
10	0	1277	0	1281	0	1340	0	1299.3±35.3	-	3
United Kingdom										
11	0	1063	0	1091	0	1288	0	1147.3±122.6	-	11
12	0	1292	0	1455	0	1642	0	1463.0±175.1	-	12
13	0	1519	0	1460	0	1742	0	1573.7±148.7	-	9
14	874	153	871	198	935	229	893.3±36.1	193.3±38.2	3	20
15	0	1354	0	1549	0	1713	0	1538.7±179.7	-	12
16	1570	66	1272	80	1363	98	1401.7±152.7	81.3±16.0	8	20
17	1361	109	1312	106	1474	145	1382.3±83.1	120.0±21.7	4	18
18	0	1354	0	1418	0	1683	0	1485.0±174.4	-	12
19	0	1355	0	1473	0	1716	0	1514.7±184.1	-	12
20	0	1327	0	1537	0	1696	0	1520.0±185.1	-	12

Results

Table 1 shows the distribution of fluoride concentration in the adult toothpaste samples. The coefficient of variation in all the 4 Na_2FPO_3 toothpaste samples was less than 10% while it was greater than 10% but not more than 20% in 14 NaF toothpaste samples in both made-in-Nigeria and made-in-UK toothpastes.

Table 3 shows the distribution of adult toothpaste samples by labeling information. None of the made-in-Nigeria toothpaste labels had their instructions in local languages. Five (50.0%) of the made-in-UK toothpaste labels had instructions about

Table 2: Comparison between stated active ingredients and their concentrations in adult toothpaste samples before and after fluoride analysis

Adult tooth paste samples	Stated active ingredient before analysis	Stated fluoride concentration before analysis (ppm)	Active ingredient after analysis	Fluoride concentration after analysis (ppm)	Percentage fluoride concentration
Nigeria					
1	Na_2FPO_3	1450	NaF+Na_2FPO_3	379	26.1%
2	NaF	1450	NaF	1080	74.5%
3	Na_2FPO_3	NS	NaF	1056	-
4	NaF	1450	NaF	1036	74.4%
5	NaF	NS	NaF	43	-
6	NaF	1450	NaF	1260	87.0%
7	Na_2FPO_3	NS	NaF	29	-
8	NaF	NS	NaF	19	-
9	NaF	1450	NaF	1444	99.6%
10	NaF	1450	NaF	1299	92.8%
United Kingdom					
11	NaF	1450	NaF	1147	79.1%
12	NaF	1450	NaF	1463	100.7%
13	NaF	1450	NaF	1574	108.5%
14	NaF+Na_2FPO_3	1450	NaF+Na_2FPO_3	1086	74.9%
15	NaF	1450	NaF	1539	106.1%
16	NaF+Na_2FPO_3	1450	NaF+Na_2FPO_3	1402	96.7%
17	NaF+Na_2FPO_3	1450	NaF+Na_2FPO_3	1502	103.6%
18	NaF	1450	NaF	1485	102.4%
19	NaF	1450	NaF	1515	104.5%
20	NaF	1450	NaF	1520	104.8%

NaF – Sodium fluoride
Na_2FPO_3 – Sodium monofluorophosphate
NS – Not stated

Table 2 shows that 4 made-in-Nigeria toothpastes had fluoride concentrations below 500 ppm while none of the made-in-UK toothpaste had fluoride concentration less than 1000 ppm. No made-in-Nigeria toothpaste label stated that they contained both NaF and Na_2FPO_3 while it was written on 3 made-in-UK toothpaste labels. Fluoride concentrations were not stated on the labels of 4 made-in-Nigeria toothpastes while it was stated on the labels of all made-in-UK toothpastes. Two made-in-Nigeria toothpastes had different active ingredients after fluoride analysis when compared to the active ingredients stated on their labels. The active ingredients stated on all made-in-UK toothpaste labels were the same after fluoride analysis.

changing toothbrush every 3 months and visiting the dentist regularly while no made-in-Nigeria toothpaste labels had these information. Only 1 (10.0%) of the made-in-Nigeria toothpaste labels had information on how teeth should be cleaned and number of times it should be done while 9 (90.0%) of the UK toothpastes had this information. Only 1 (10.0%) UK toothpaste had information about when there is allergy to ingredients, don't use consult dentist or doctor, storing toothpaste below 25°C, not using toothpaste after expiration, keeping toothpaste away from children and flossing regularly and rinsing with

mouthwash. None of the Nigerian tooth paste had these instructions. The majority 9 (90.0%) of the toothpastes from the UK had instructions about children appropriate use of toothpaste while only 2 (20.0%) Nigerian toothpastes had this information.

In this study, the coefficient of variations in fluoride concentrations in all the Na_2FPO_3 and NaF toothpaste samples from the three parts of the tubes after fluoride analysis were small, thereby indicating that the samples were less variable and more stable

Table 3: Distribution of adult toothpaste samples by labeling information

Labeling information	Adult toothpaste samples	
	Nigeria	UK
Brush thoroughly at least twice daily	0	9
Change tooth brush every 3 months	0	5
Visit dentist regularly	0	5
Allergy to ingredients, don't use consult dentist or doctor	0	1
Do not store above 25^0C	0	1
Do not use after expiring date	0	1
Floss regularly	0	1
Rinse with mouthwash	0	1
Use pea-sized toothpaste for children	2	10
Supervised children's tooth brushing	2	9
Consult dentist if child is using fluoride supplements	2	10
Keep away from children	0	1

Discussion

The fluoride concentration of toothpaste is one of the variables that may affect fluoride ingestion from toothpaste [33]. Three factors have an important influence on the anticaries efficacy of fluoride toothpaste, namely concentration, frequency of brushing and post brushing rinsing behavior [34]. Well-formulated fluoride toothpastes are clinically proven to prevent and control dental caries [34]. They may also be a risk factor in the aetiology of dental fluorosis [34], especially if the fluoride concentration in them is high. Caries preventive effects of fluoride toothpastes of different concentrations increase with higher fluoride concentration [26,34]. Low-fluoride toothpastes are appropriate for very young children (under 7 years) at low caries risk, particularly if living in fluoridated areas [34]. The difference between toxic and therapeutic concentrations of fluoride ions is rather small, [35] therefore, it is crucial to determine accurately and precisely the amount of fluoride in toothpaste. It is important to provide information regarding the concentration and source of fluoride ions on toothpaste labels. Cochran *et al.* [33] stated that there appears to be a need for clearer health messages regarding the use of fluoridated toothpaste by young children. Health messages regarding the appropriate use of fluoridated toothpaste and other oral hygiene messages can be placed on toothpaste labels.

or more uniform. Noh and Coetzee [36] stated that fluoride ion-selective electrode is versatile for low-level fluoride determination in routine laboratories provided that the correct analytical procedures are followed. The versatility of F-ISE may be responsible for the observed coefficient of variation in this present study.

The World Health Organization recommends that about 1000 ppm to 1500 ppm fluoride be incorporated into toothpastes [37]. Meta-analysis studies and systematic reviews reveal consistent proof that toothpastes with this concentration of fluoride are more effective than those with fluoride concentration below 500 ppm [28,38]. Dos Santos and colleagues [39] in their systematic review and meta-analysis of the effects of fluoride toothpastes on the prevention of dental caries in the primary dentition of preschool children reported that low fluoride toothpastes (< 600 ppm) are only effective at surface level while standard fluoride toothpastes (1000 – 1500 ppm) are efficacious at surface, tooth and individual levels. Fluoride concentration in 4 of the 10 locally made Nigerian toothpastes after analysis were lower than this recommended concentration whereas all the toothpastes from the UK had this recommended fluoride concentrations. This low fluoride concentration in some toothpaste samples from Nigeria was similar to the findings from a previous study [40] in Tanzania where all the toothpaste samples had low fluoride concentration. One of the 4 made-in-Nigeria toothpastes that

contained less than 1000 even stated on its label that it contains 1450 ppm fluoride, the rest did not mention the amount of fluoride they contain. Furthermore, none of the remaining 6 had up to the claimed values after the analysis. This difference in the stated fluoride concentration and the actual amount of fluoride in toothpaste is in agreement with the report by van Loveren *et al.* [29] that toothpastes in non-established market economy do not contain the amount of fluoride claimed by toothpaste manufacturers in these countries. Having lower level of fluoride than the recommended level in toothpastes may result in negative consequences to oral health especially for people with high caries risk since reports [34,41,42] have shown an inverse relationship between incidence of caries and fluoride levels. Toothpaste manufacturers should ensure that their products have the optimal fluoride concentration for dental caries prevention [40]. Using well-formulated toothpaste in children especially in non-fluoridated areas may not require fluoride supplementation, to prevent dental fluorosis.

The low fluoride concentration in some Nigerian toothpastes might have accounted for the least effectiveness of toothpaste brands that contained fluoride in reducing oral flora as reported by Okpalugo *et al*. [43] in their study on toothpaste formulation efficacy in reducing oral flora. A previous Nigerian study [44] on assessment of in vitro and in vivo antimicrobial activities of selected Nigerian toothpastes and mouthwashes on some oral pathogens reported that most toothpaste lost their in vitro antimicrobial activities when concentration of their active ingredient is low. A research to assess reasons why these low- fluoride- level toothpastes are manufactured might be needed to further help to address this problem since some undocumented reports mentioned the need to provide affordable fluoride toothpastes at low cost as the reason why companies manufacture low- fluoride- containing toothpastes.

In this study, some made-in-Nigeria toothpastes did not state completely their active ingredients as well as the concentration of fluoride on their labels. All the made-in-UK toothpastes stated the concentration of fluoride on their labels. After fluoride analysis, 2 made-in-Nigeria toothpastes had different active ingredients when compared to the active ingredients stated on their labels while the active ingredients were the same with what was stated on the labels of all toothpastes made in the UK. Placing adequate and correct information about the active ingredients of toothpastes and their concentrations on their labels provide an avenue for oral health care practitioners and patients to make informed decisions on fluoride use. Choice is made difficult by lack of clear standard labeling on toothpaste packaging [45].

In this study, none of the made in Nigeria toothpaste labels had their instructions in local languages. Providing instructions in local Nigerian dialects especially major dialects on toothpaste labels will ensure adequate understanding of the message by the Nigerians who cannot read or write in English. Half of the made-in-UK toothpaste labels had instructions about changing toothbrush every 3 months and visiting the dentist regularly while none of the made-in-Nigerian toothpastes had these instructions. Changing toothbrush every three months and visiting the dentist regularly might be a good practice that will improve oral health. This might not be feasible in Nigeria due to economic reason and the kind of available health system where patients pay for health care services out of their pockets. However, instructions such as changing toothbrush when the bristles are bent and splayed might be suitable and practicable for the majority of Nigerians who are low income earners. Bending and splaying of toothbrush bristles was selected as the main indicator that a toothbrush should be renewed by dentists [46,47] and patients [48]. In general, softer bristle textures, tapered bristles and cross angled bristle arrangement have been associated with increased efficiency in interproximal cleaning in laboratory and clinical studies [49]. Regulatory agencies in the UK should ensure that all toothpaste labels bear instructions on changing toothbrushes when they are splayed to enhance adequate oral health of the populace.

Information on how and number of times teeth should be cleaned should be made available for the public on toothpaste labels. Brushing twice daily for 2 minutes each with a good technique can facilitate plaque removal and reduce risks of caries and periodontal diseases [50]. Adverse reactions to toothpastes are rare but should be considered in unexplained skin or respiratory allergies and gingival or lip lesions [51]. The total fluoride content of toothpaste can be lost after sometime and when stored at or above room temperature [52,53]. Therefore, information about what to do when there is an allergic reaction to ingredients in toothpastes, storing toothpaste below 25^0C, not using toothpaste after expiration as well as flossing regularly and rinsing with mouthwash are necessary on toothpaste labels to ensure adequate oral health care. However, it was surprising to note that very few Nigerian toothpastes had these instructions as compared to their UK counterparts. Therefore, regulatory

agencies in Nigeria should ensure that these vital instructions are labeled on toothpastes so as to provide information to the generality of the public about how to maintain adequate oral health.

Instructions about children use of toothpastes should be placed on toothpaste labels especially those belonging to adults, for effective children oral health. This is necessary since children use these adult toothpastes due to ignorance and unavailability of their own toothpastes. Reports [45,54-56] have shown that misuse of fluoride supplements and fluoridated oral hygiene products such as toothpastes by children could result in dental fluorosis. It was observed in this study that very few toothpastes from Nigeria had instructions on fluoride use in children on their labels compared to the UK toothpastes. The Center for Disease Control in the United States, the European Association of Peadiatric Dentistry and the Scottish Intercollegiate Guidelines Network [56-58] reported that for children below 6 years a pea-sized amount of adult toothpaste should be used with parental supervision and the child should be encouraged to spit with restricted use no more than two times a day. The European Association of Peadiatric Dentistry recommends that a smear should be used for children below 2 years (55,56). These instructions are encouraged to be labeled on the toothpaste tube along with the concentration of fluoride for the guidance of parents [57], this is a mandatory procedure in the United States. Other instructions such as spitting out excess toothpastes and non-swallowing of toothpastes by children should also be included in the labeling information. This holds true even when the currently recommended pea-sized amount is stated on the labels.

In conclusion, toothpastes from the UK had appropriate active ingredients and adequate level of fluoride. The majority of toothpastes made from the UK had labeling information as compared to their counterparts from Nigeria. Toothpaste manufacturers in Nigeria need to provide adequate information on good oral hygiene practices on labels which are an efficient tool in oral health education. Dental Associations and other regulatory agencies need to reappraise the efficacy of the available toothpastes in Nigeria so as to ensure that the consumers get the expected value for their money before granting accreditation to these products. They must also ensure that the correct toothpaste formulations are available to the public and adequate labeling instructions are placed on their tubes in local languages. Toothpaste manufacturers should develop toothpastes that are effective in preventing dental caries and reducing the risk for dental fluorosis for children younger than 6 years old. Appropriate labeling will allow consumers to make informed decisions and dentists, dental hygienists and other healthcare professionals to correctly advice patients regarding fluoride intake and use of other products. Using appropriate active ingredient and concentrations will allow for effectiveness of toothpaste which will translate to better oral care of the public.

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