

Could changes in UK trade agreements affect fluoride content of imported foods?

It is well-known that fluoride has a beneficial effect on the prevention of tooth decay; however an adverse effect of prolonged exposure to excess fluoride is dental fluorosis. In the UK, the prevalence of any form of fluorosis has been most recently estimated at 55% in fluoridated areas and 27% in non-fluoridated areas for 11-13 year olds.¹ Other European countries and the USA have determined the prevalence of fluorosis in the population and recognise the importance of monitoring fluoride intake.²

In 2010, the World Health Organisation released a declaration stating the adverse effects of excess fluoride and highlighting that, in addition to fluoride toothpastes and varnishes, there can be high levels of fluoride present in drinking water and food.³ Fluoride is not considered to be an essential nutrient because it is not required for any function within the body. As a result, fluoride content of food and drink is not stated on nutrition labels and, aside from the USA, fluoride is not included in food composition tables.^{4,5} This can make it difficult for individuals to monitor fluoride intake.

Why is fluorosis an issue?

Although fluorosis is primarily an aesthetic problem, it can lead to psychological affects in some children and affect their quality of life. Additionally, moderate-to-severe cases of fluorosis can have porous enamel layers which stain dark-brown and fracture easily.⁶ Fluoride primarily affects the early stages of enamel formation and so the permanent front teeth, which have the highest aesthetic concern, are critically affected by fluoride between 2-3 years of age. Maturation of the crowns of all permanent teeth, excluding wisdom teeth, is finished by 8 years of age, along with the risk of dental fluorosis.⁷

How much fluoride is too much?

Seminal epidemiological research has established that an average fluoride intake of 0.1mg/kg body weight per day is the level beyond which moderate dental fluorosis appears in some children.⁸ Based on this, the UK Committee on Toxicity has set an Adequate Intake where fluoride has a beneficial effect on the prevention of tooth decay with 'no observed adverse effect level' for moderate fluorosis. In addition, a Tolerable Upper Intake Level has been set, beyond which moderate fluorosis has a high risk of occurrence (*Table 1*).⁴

Fluoride content of food and drink

When assessing available literature, of 118 food and drink items, approximately a fifth (23) were found to have a fluoride content of above 1.0mg/L or 1.0mg/kg. There are limited studies from the UK regarding the fluoride content of food and drink items. These examined some staple foods including cereal, chicken and pasta and found that each had a fluoride content of less than 1.0mg/kg.⁹⁻¹¹ However, studies have shown that the USA, Spain and Brazil contain a variety of food and drink items that have higher fluoride contents. The USA had 8 items, Spain had 11 items and Brazil had 4 items of food or drink with a fluoride content of above 1.0mg/L or 1.0mg/kg (*Table 2*).

Do we need to worry in the UK?

At the moment food and drink items from the UK seem to have a consistently low level of fluoride. Therefore, there is a low cause for concern. However, the UK receives a proportion of food and drink from other countries, for example the USA. In

addition, the importation of food and drink could increase with the UK's decision to withdraw from the European Union and after a trade agreement has been set with the USA. In 2017, an estimated 30% of UK food was imported from the EU with North America providing only 4%.¹⁵ This 4% has the potential to increase post-Brexit. Care must be taken when consuming these imported foods as they are found to contain higher levels of fluoride and may have the potential to cause dental fluorosis.

The risk of fluorosis is increased for the 10% of the population who receive fluoridated water. In addition, dental public health initiatives in the northwest of England have introduced fluoridated milk in schools and regular fluoride varnish applications in Scotland and Wales.

Other countries

White grape juice from the USA was found to have a fluoride content of 3.92mg/L, with a recommended portion size of 240ml. Therefore, it can be calculated that there is 0.94mg of fluoride per portion. In addition, salted fish from Spain was found to have a fluoride content of 9.25mg/kg and pureed chicken from USA had 5.58mg/kg fluoride. Using a 50g recommended portion size for a toddler, salted fish has 0.46mg fluoride and pureed chicken has 0.28mg fluoride per portion.

If a child aged 1-3 years were to frequently consume these food and drinks and receive fluoridated water, the 1.5mg/day Tolerable Upper Intake Level would be reached. This is the threshold beyond which moderate dental fluorosis has a high risk of occurrence.

Conclusion

To enable the careful monitoring of fluoride intake, it would be useful if fluoride was included in food composition tables. In addition, it may be useful for dental practitioners to carry out a diet analysis before prescription of a high fluoride toothpaste or fluoride varnish to children. The risk of fluorosis is increased for children in areas which have fluoridated water and in those who regularly receive additional fluoride as part of a dental public health intervention.

Further research is required to confirm these conclusions and additional experiments which test the fluoride content of a larger quantity and range of food and drink are essential.

References

1. McGrady, M. et al. 2012. *The association between social deprivation and prevalence and severity of dental caries and fluorosis in populations with and without fluoridation*. *BioMed Central Public Health*. 12(1122), pp.1-17.
2. Whelton, H. et al. 2004. *A review of fluorosis in the European Union: prevalence, risk factors and aesthetic issues*. *Community Dentistry and Oral Epidemiology*. 32(1), pp.9-18.
3. World Health Organisation. 2010. *Inadequate or excess fluoride: a major public health concern*. *Public Health and Environment*. pp. 1-5.
4. COT. 2000. *COT statement on fluorine in the 1997 total diet study*. *Committee on Toxicity*. pp.1-14.
5. EFSA. 2013. *Scientific opinion on dietary reference values for fluoride*. *European Food Safety Authority*. 11(8), pp.1-46.
6. Moimaz, S. et al. 2015. *Dental fluorosis and its influence on children's life*. *Brazilian Oral Research*. 29(1), pp.1-7.
7. DenBesten, P. Li, W. 2011. *Chronic fluoride toxicity: fluorosis*. *Monographs in Oral Science*. 22(1), pp.81-96.
8. Dean, H. 1942. *The investigation of physiological effects by the epidemiological method*. *American Association for the Advancement of Science*. 19(1), pp.23-33.
9. Maguire, A. et al. 2012. *Fluoride content of ready-to-feed (RTF) infant food and drinks in the UK*. *Community Dentistry and Oral Epidemiology*. 40(1), pp.26-36.
10. Vlachou, A. et al. 1992. *Fluoride concentrations of infant foods and drinks in the United Kingdom*. *Caries Research*. 26(1), pp.29-32.
11. Zohoori, F. et al. 2012. *Impact of water fluoride concentration on the fluoride content of infant foods and drinks requiring preparation with liquids before feeding*. *Community Dentistry and Oral Epidemiology*. 40(1), pp.432-440.

12. Stannard, J. et al. 1991. Fluoride levels and fluoride contamination of fruit juices. *Journal of Clinical Paediatric Dentistry*. 16(1), pp.38-40.
13. Fein, N. Cerklewski, F. 2001. Fluoride content of foods made with mechanically separated chicken. *Journal of Agricultural and Food Chemistry*. 49(9), pp.4284-4286.
14. Rocha, R. et al. 2013. Quantification of fluoride in food by microwave acid digestion and fluoride ion-selective electrode. *Journal of Agricultural and Food Chemistry*. 61(1), pp.10708-10713.
15. Department for Environment Food and Rural Affairs 2018. *National Statistics Food Statistics in your pocket 2017 - Global and UK supply* <https://www.gov.uk/government/publications/food-statistics-pocketbook-2017/food-statistics-inyour-pocket-2017-global-and-uk-supply> Accessed 30/09/2019

Table 1: Adequate Intake and Tolerable Upper Intake Level of Fluoride using Reference Weights^{3,4}

Age	Reference Weight	Adequate Intake	Tolerable Upper Intake Level
1-3 years	15 kg	0.75 mg/day	1.5 mg/day
4-8 years	25 kg	1.25 mg/day	2.5 mg/day

Table 2: Food and Drink Items from the USA, Spain and Brazil with a High Fluoride Content¹²⁻¹⁴

Country of Origin	% Receiving Fluoridated Water	Food/Drink Item	Fluoride Content (mg/L or mg/kg)
USA	74%	Dr. Pepper	1.02
		Apple-plum juice	1.25
		White grape juice	3.92
		Peach juice	1.15
		Pineapple juice	1.35
		Chicken, pureed	5.58
		Chicken, slices	3.61
		Turkey, slices	1.37
Spain	10%	Salmon	4.17
		Salted fish	9.25
		Shrimp	9.98
		Smoked fish	2.10
		White fish	2.86
		Rice	2.20
		Broccoli	4.76
		Celery	2.83
		Cucumber	1.89
		Lettuce	1.68
		Mushroom	3.80
Brazil	41%	Cereal, oat	5.00
		Biscuit, chocolate, wafer	2.92
		Biscuit, strawberry, wafer	3.33
		Chocolate, M&Ms	1.60