who had sanitary facilities, although emphasis must be placed on the fact that 82,9% of the reported facilities were not in a fit condition for use.

In view of the fact that this is the international safe drinking-water supply and sanitation decade (1981-1990), it is believed that the findings of this paper are of particular significance to decision-makers and it is hoped that it will urge them to give priority to under-served rural populations, and to promote and implement the concept of safe drinking-water supplies and sanitation as an essential component of primary health care.

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REFERENCES


Salmonella isolated from rooibos tea

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Summary

Various Salmonella serovars were isolated from rooibos tea, a natural, untreated agricultural product. The results of a study to identify the serovars is reported. The possibility of lizard origin is discussed and the low pathogenicity of the salmonellae isolated is highlighted.


The contamination of food from animal origin with Salmonella is well known and has been widely documented. It is unusual, however, for untreated foods of vegetable origin to be contaminated with Salmonella or other enterobacteria. An exhaustive search of the literature yielded only a few relevant publications. In the environment enterobacteria are usually restricted to water supplies contaminated by faeces. Untreated foods of plant origin would naturally be contaminated with normal soil bacteria.

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Materials and methods

From November 1984 to August 1985, 155 Salmonella cultures isolated from rooibos tea were received (Table I). Each culture was biochemically examined and serotyped. Slide agglutination procedures were followed (M. L. Swanepoel — unpublished data) for the determination of both the O and H antigens, using either commercially available antisera (Difco and Wellcome Diagnostics) or antisera produced at the Veterinary Research Institute, Onderstepoort.

For the O-antigen typing each culture was inoculated onto blood agar plates for 18 - 24 hours at 37°C. For the H-antigen determination each culture was inoculated onto a swarm agar plate and incubated for not longer than 24 hours before typing. Each culture was tested for roughness in a 1/500 acriflavine saline solution.

Although the H antigens of subspecies III serovars were included unexpectedly large variety of serovars, 49 different ones in the Kaufman-White scheme, they are difficult to identify and serotyping of S. arizonae beyond O-antigen level was not undertaken.

Results

The various identified Salmonella serovars are given in Table I. The majority, 103/155 (66,5%) of the isolates were identified as subspecies II serovars, while only 50/155 (32,2%) belonged to subspecies I. Subspecies III organisms were identified twice only. No subspecies IV or V serovars were identified. A surprisingly small number, 9/155 (5,8%), of rough salmonellae were found, 7 of which belonged to subspecies 1 and 2 to subspecies II (Table I).

An unexpectedly large variety of serovars, 49 different ones in fact, were identified. Three of them, S. II (grabouw), S. II (alsterdorf) and S. II 40a/p6 were predominant, while the other 46 serovars were each found only infrequently. Three isolates were biochemically identified as Salmonella (Table I), but were not completely serotyped since this laboratory does not have facilities for identifying all O antigens.
TABLE I. SALMONELLA SEROVARS ISOLATED FROM ROOIBOS TEA


Subtotal 50

S. choleraesuis salamae serovars (subspecies II): S. II (alsterdorf) (26), S. II 40; a; z6 (16), S. II (grabouw) (10), S. II 30; gms; enx (6), S. II 1,9,12; gmst; 1,5:z42 (5), S. II (bechuana) (4), S. II 40; 1,228; z42 (4), S. II 9,12; z42; 1,5,7 (4), S. II (rhodesienese) (2), S. II 47; zmz (15) (2), S. II (duivenhoks) (2), S. II (kuilrivier) (2), S. II (durbanville) (1), S. II 1,4,12,27; z; 1,5 (1), S. II 9,12; gmst; 1,5,7; z42 (1), S. II (slatograd) (1), S. II 1,4,5,12; fgt; z6; z42 (1), S. II (sunnydale) (1), S. II (beloha) (1), S. II (limbe) (1), S. II (lethe) (1), S. II 6,7; gmst; 1,5 (1), S. II 6,7; gmst; enx (1), S. II (calvina) (1), S. II (atra) (1), S. II 43; d; z39 (1), S. II 6,7; k; z3 (1), S. II 41; k; z6 (1), S. II 40; mt; z39 (1), S. II (1), rough (2)

Subtotal 103

S. choleraesuis arizonae serovars (subspecies III): S. III 13,22 (1), S. III (1)

Subtotal 2

Total 155

Discussion

In comparison with the vast amount of literature on the contamination of meat and animal by-products with Salmonella, very little reference could be found to the occurrence of Salmonella in vegetable products. In cases where salmonellae had been found, the incidence of contamination was low: Bockemühl and Wohlers found 8,1% of untreated dried vegetable products to be contaminated with Salmonella; Rude et al. found 8% contamination of fresh vegetables; Al-hindawi and Rishied found contamination in 1,4% of olives and 0,85% of vegetables but no contamination of fruit or fruit juices. Only one reference could be found of tea being contaminated with Salmonella.

The large number of identified serovars as well as the low incidence of individual serovars indicate that the organisms could have originated from different sources rather than from a single one. Contaminated water supplies, birds, worker's hands, rodents, reptiles and insects could all have acted as sources of contamination.

None of the identified serovars was of the highly pathogenic salmonellae such as S. typhimurium or S. paratyphi A or B, which had been predominantly isolated from food of vegetable origin.

Salmonella found by other authors in foods from vegetable origin were subspecies I serovars, but in our case the majority of the strains were subspecies II serovars. The usual habitat of subspecies II serovars is the gastro-intestinal tract of cold-blooded animals. These organisms are also isolated from warm-blooded animals and man.

Various environmental sources might have been involved in the contamination of the tea. It might have happened on the pastures via contaminated irrigation water or fertilisers. Likewise, some of the water in the processing cycle could have been contaminated with Salmonella. Almost all animals might act as reservoirs for salmonellae and many animal species could have transmitted the organisms to the tea during the various processing stages.

However, special reference should be made to the wide variety of salmonellae that can be harboured by reptiles, especially lizards. Salmonellae appear to be part of their natural gut flora. The main reservoirs for S. arizonae subspecies are reptiles and poultry, although they have occasionally been isolated from man. The identification of the two S. arizonae serovars, together with the wide variety of salmonellae suggests that lizards might have played a major role in the contamination of the tea.

The fact that none of the more virulent salmonellae were isolated is comforting. The virulent S. typhimurium, S. paratyphi, etc., usually isolated from meat or other animal products, are of greater danger to human health than the organisms isolated from the tea.

I should like to acknowledge the help of Ms Helena Steyn in the identification of the strains.

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