Food antioxidant capacity and its use in food selection

In the current issue of the Journal, Louwrens and co-workers determine the per capita South African daily dietary total antioxidant capacity (TAC)[1] using published data by Nel and Steyn (2002) which summarises the food consumption studies conducted in SA from 1983–2000. The data reflect the daily per capita intake of food and beverages as based on those foods and beverages consumed by more than 3% of South African adults of all ages and ethnic groups.[2] Using this dietary data, they calculate the Total Antioxidant Capacity (TAC) using the Oxygen Radical Absorbance Capacity (ORAC) values for the closest matching foods as reported by the United States Department of Agriculture (compiled for typical foods available in the US).[3] For foods not found in the USDA (US Department of Agriculture) ORAC database and for which no equivalents could be found, ORAC analyses were done (for the hydrophilic chain breaking antioxidant capacity only). The authors report TAC values ranging from as low as 7 635 µmoles Trolox Equivalents (TE) (for the Lebowa study) to 15 934 µmoles TE (for the CORIS study) and an average of 11 433 µmoles TE for all the 11 studies summarised. The authors conclude that a TAC of 20 513 µmoles TE per person per day is the recommended TAC objective (based on a diet compiled using the five-a-day concept) and that diet choices should be made with this in mind. Due to the fact that the estimated South African dietary TAC, as calculated from the secondary data published by Nel and Steyn, is 11 433 µmoles TE, the authors further conclude that the average estimated adult South African dietary TAC is only about half of what it should be.[1]

There is a large amount of supporting evidence on the role of dietary antioxidants and their contribution to disease prevention (cancer, cardiovascular disease and neurodegenerative diseases, in particular),[4,5] through mechanisms that modulate free radical attack on nucleic acids, proteins and polyunsaturated fatty acids.[6-8] For this reason, consideration of antioxidant capacity in dietary food choices could be of value. However, before this information is applied to food selection or communicated to the public, there are a number of important considerations that need to be addressed. As described by the authors, the TAC values reported are rough estimates. This is due to the fact that the methodology used for calculating these values does leave room for error. Firstly, as accurately stated by the authors, the reference tables reported by Nel and Steyn for studies conducted between 1983–2000, may not necessarily represent the entire South African population accurately nor the current food and beverage intakes of these groups in 2009.[1] Due to the fact that fruit and vegetables have become more accessible over the years,[9] we expect that this calculation of TAC may be largely underestimated for the general South African population in 2009. Secondly, the food consumption summaries by Nel and Steyn do not report in enough detail the types of foods consumed in order to make an accurate selection of the corresponding ORAC values from the USDA's ORAC reports. For example, according to the USDA ORAC reports, there is large variation in TAC of various apple cultivars (TAC for golden delicious = 2 670 and TAC for red delicious = 4 275) and Nel and Steyn report a consumption of apples for instance with no information of its cultivar.[2] This also applies to many of the other foods reported e.g. tea and coffee, the concentration of which may vary drastically due to variations in preparation methods and/or preferences of the consumer for either percolated or instant, with or without chicory. Additionally, Louwrens and co-workers report the Lebowa study to have the lowest calculated TAC out of all 11 reports,[1] however, Nel and Steyn report the general dietary composition of this group to compare favourably with that of children and adults for rural South Africa as a whole.[2] The only major differences in the Lebowa study population according to Nel and Steyn, is that the participants consumed larger portions of maize porridge, wild green leaves, tomato and onion stew and non-dairy foods.[2] Once again, due to the fact that wild green leaves (reported to have high antioxidant capacities)[10] and composite foods such as the tomato and onion stew are not reported in the USDA ORAC database,[3] nor were they determined in this study, and although similar foods were selected for the dietary TAC determinations, the absence of accurate information regarding these foods may have led to further underestimations. Thirdly, it is well known that the TAC of the same foods can vary significantly depending on factors such as rainfall, temperature, fruit ripeness, soil conditions, storage conditions and related factors.[11,12] Hence, one would expect variations within the same species of fruit, grown on the same farm from year to year, not even to mention the variation one could expect if one had to analyse foods grown and consumed in different countries. Lastly, the advantage of ORAC for determining TAC is that one can determine the TAC of the lipophilic (L-ORAC) and hydrophilic (H-ORAC) fractions, and, when combined, Total ORAC. In the Louwrens' and co-workers' study, only H-ORAC was predominantly used. In this regard, and although, for many foods L-ORAC contributes to only a small proportion of the Total ORAC (1–10%), in grains and sorghum this contribution could be as high as 20%, with L-ORAC values of approximately 2 000 µmoles TE/100 g portion.[3] Hence, eliminating this from the TAC could influence the results extensively, leading to further underestimations.

The next important consideration relates to the relevance of having dietary TAC values for various foods and its use for food selection in the context of the South African food based dietary guidelines (FBDG). Although there exists a general consensus regarding the value of antioxidants in food and their associated health benefits, the use of dietary TAC values in food selection may be controversial. Louwrens and co-workers recommend, based on the low dietary TACs calculated, that the South African population needs to be educated regarding antioxidant capacity/antioxidants in foods and that the FBDG need to be adapted to accommodate foods with higher TACs in order to enable consumers to achieve better food choices.[1] They further recommend that better dietary antioxidant capacity can be achieved by following guidelines as previously proposed by other research groups e.g. increased intakes of fruits and vegetables[13] by following the five-a-day concept, eating dry beans, peas, lentils and soy[14] and making starchy foods the basis of most meals by eating more cereals and grains in the unprocessed form[15] as three servings[16] in addition to drinking lots of clean water, in the form of tea.[17] These recommendations are, however, already incorporated into South African FBDG.

Additionally, there is a danger in advising food selection based on antioxidant capacity as one cannot predict how such information may be perceived and misused. Red wine (6 675 µmoles TE/250 ml) and dark chocolate (24 600 µmoles TE/100 g) for instance, have extremely high antioxidant capacities.[18,19] If < 100 g of chocolate is all that is required to more than cover the daily recommended 20 513 µmoles TE, one immediately questions the value of food TACs and its applications to dietary recommendations or food selection. Furthermore, the high antioxidant capacities of the above-mentioned potentially harmful foods/beverages may be used to market these foods as being healthy for the purposes of increasing consumption and commercial benefit.

In summary, although no one can deny the putative health benefits of dietary antioxidants, before any firm conclusion can be made about the true TACs of South African diets in general and the optimal daily TAC intake in particular, accurate ORAC analyses of all South African foods (and composite foods) need to be completed. Secondly, although the information Louwrens and co-workers document for the first time in the country is important from a disease prevention perspective, its application for use in dietary food choices for the general South African population may be a significant challenge, depending on how this information may be interpreted and/or misused by both industry and consumers. One last consideration perhaps, is that food insecurity is most probably the primary contributor to a reduced antioxidant intake (a lower consumption of food in general due to poverty as opposed to incorrect food choices). If this is the case, we should then be addressing food insecurity from a socioeconomic perspective first, using the current South African FBDG.

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