The impact of human ageing on the detection of key aroma compounds identified in a milk-based high-protein beverage.

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Introduction

Olfaction is a key contributor to flavour perception. It has been proposed that age-related impairments may impact on older adults experience and enjoyment of foods (Duffy et al, 1995). Subsequently, it may become difficult for older adults to achieve their nutritional intake in order to maintain muscle mass and physical function (Somekawa et al, 2017). It is well documented that the sense of olfaction decreases with age (Murphy, 2002); however, it is not yet known how aging impacts the detection of aroma compounds which are key to the flavour of a high-protein product.

Stage1: Gas-Chromatography Olfactometry (GC-O)

Objective: *to determine the key aroma compounds in a high-protein milk-based beverage*

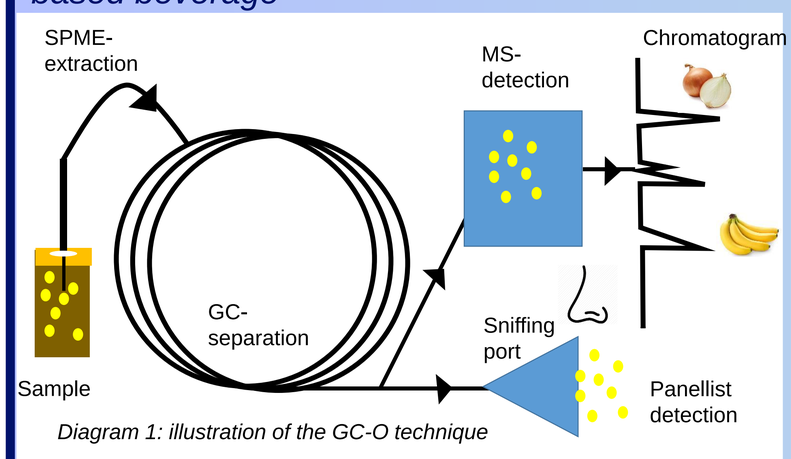


Diagram 1: illustration of the GC-O technique

7ml of a banana flavour milk-based high-protein beverage was placed in a vial and agitated at 37ºC. SPME was used to extract volatile aroma compounds which were then separated by Gas Chromatography (GC). The eluting aroma compounds were then split between the Mass Spectrometer (MS) (for identification) and the Sniffing Port, for detection by panellists.

6 healthy young adults (24-38 years) and 6 healthy older adults (67-81 years) were recruited.

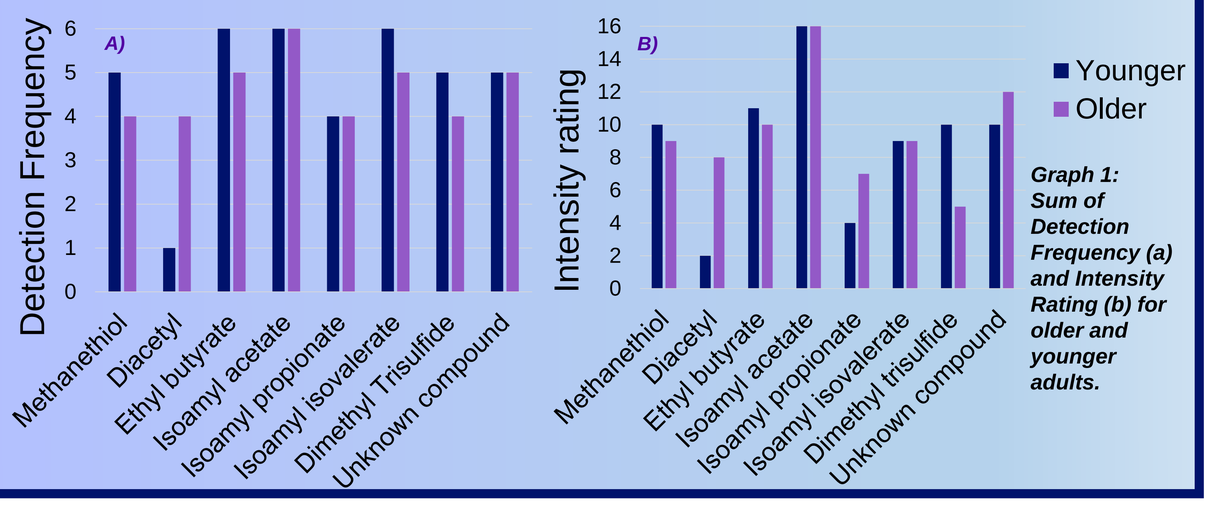
Data was collected by a combination of **Detection Frequency** and **Posterior Intensity Rating**.
Panellists were instructed to:

1) State the exact moment they detect an odour.
2) Rate the intensity of the odour on a simple ordinal scale (1 = weak, 2 = moderate, 3 = strong)
3) Describe the aroma using sensory descriptions

Results

Table 1: The detected compounds and sensory descriptions generated by all panellists (n=12). Ordered by (i) Sum of Detection Frequency (DF) and (ii) Sum of Intensity Rating

Key compound	Sensory descriptions	DF (Sum)	Intensity (Sum)
Isoamyl acetate	Banana, Fruity, Sweet, Pear, Ester	12	32
Ethyl butyrate	Fruity, Estery, Cherry, Fruity, Sweet, Strong	11	21
Isoamyl isovalerate	Fruity, Not pleasant, Sulfury, “Off”-food, Ammonia, Cheesy, Vegetable, Not sweet	11	18
Unknown compound	Sweet, Musty, Medicine, Iron, Burnt-nuts, Bread, Milky, Bitter, Earthy, Dry, Flour, Cooked, Savoury, Cake, Donuts	10	22
Methanethiol	Bad, Rotten, Earth, Sulfury, Unpleasant	9	19
Dimethyl Trisulfide	Onion, Cooked, Cabbage, Sulfur, Chemical	9	15
Isoamyl propionate	Sweet, Fruity, Estery	8	11
Diacetyl	Sweet, Caramel	5	10



Graph 1: Sum of Detection Frequency (a) and Intensity Rating (b) for older and younger adults.

Stage 2: Detection Threshold Tests

Objective*: to determine how younger and older adults differ in detection thresholds for key aroma compounds (identified in Stage 1).*

24 healthy older adults (62-80 years) and 24 healthy younger adults (18-44 years) were recruited.

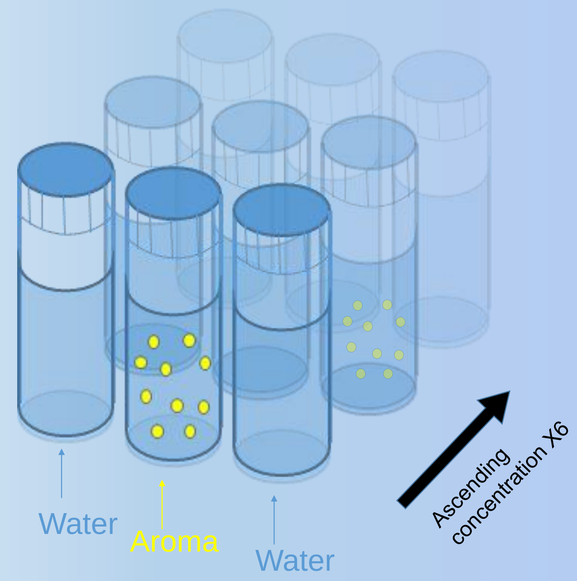


Diagram 2: Aroma concentrations were presented to panellists in a randomised 3-AFC design in an ascending order.

Table 2: The different aroma compounds and concentration ranges used.

Aroma compound	Concentration range (ppb)
Isoamyl acetate	25-6000
Methanethiol	0.025-6
Dimethyl trisulfide	0.002-0.5
Diacetyl	1-200

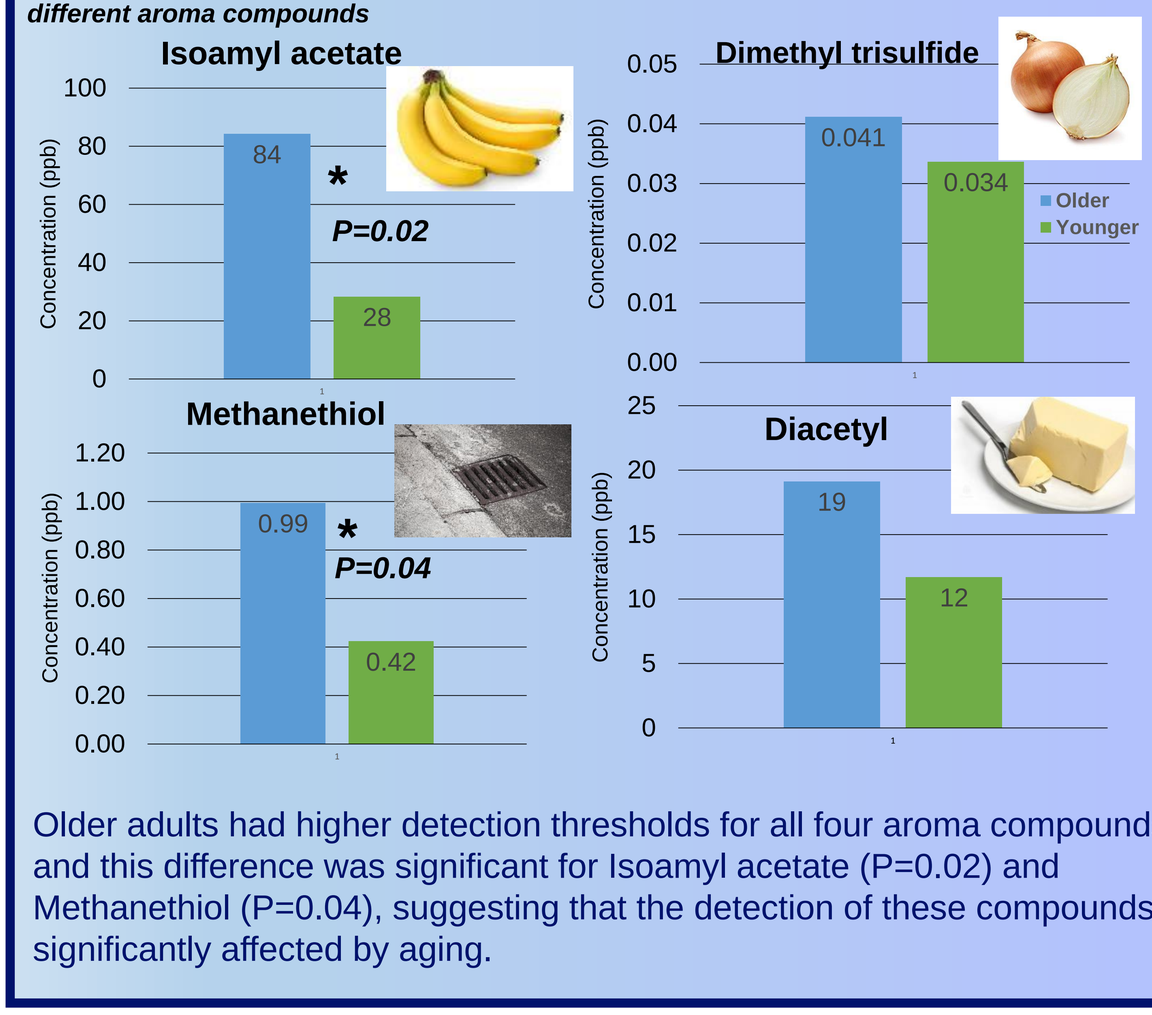
6 ascending concentrations of aroma were prepared in purified water, each separated by a factor of 3.

Panellists were asked ‘**Which one sample smells different to the other two?”.** Their answer was recorded electronically using Compusense©.

Group “Best Estimate Thresholds” (BET) were calculated by taking the geometric mean of all individual BET within each age group. Statistical differences between age groups were analysed by the Mann-Whitney U test (P≤0.05).

Results

Graph 2: Differences in detection threshold (ppb) between older and younger adults for the different aroma compounds



Older adults had higher detection thresholds for all four aroma compounds and this difference was significant for Isoamyl acetate (P=0.02) and Methanethiol (P=0.04), suggesting that the detection of these compounds are significantly affected by aging.

Discussion

During GC-O (Stage 1), aroma compounds with a wide range of sensory properties were detected (Table 1). The same compounds were detected by both older and younger adults, DF and intensity ratings were not consistent between the age groups (Graph 1). During threshold testing (Stage 2), older adults had higher thresholds for all compounds. The detection of Isoamyl acetate and Methanethiol were significantly different between age groups (p=0.02 and p=0.04, respectively), suggesting that the detection of these compounds is significantly impeded by ageing.

Conclusion

In the current study, it was found that detection thresholds are impeded by ageing, however this was not consistent across different aroma compounds. The detection of Isoamyl acetate was most significantly affected. This research suggests that older adults may need a higher quantity of flavour in foods to perceive a characteristic banana flavour. More research is needed, at subthreshold levels and within an aroma mixture, to understand how perception changes within a real-food system.

References: Duffy VB, Backstrand JR, Ferris AM (1995) Journal of the American Dietetic Association 95:879-884, Murphy C, Schubert CR, Cruickshanks KJ, Klein BE, Klein R, Nondahl DM (2002) Jama 288:2307-2312, Somekawa S, Mine T, Ono K, Hayashi N, Obuchi S, Yoshida H, Kawai H, Fujiwara Y, Hirano H, Kojima M (2017) The journal of nutrition, health & aging 21:710-714.