

<http://www.pjbs.org>

PJBS

ISSN 1028-8880

**Pakistan
Journal of Biological Sciences**

ANSI*net*

Asian Network for Scientific Information
308 Lasani Town, Sargodha Road, Faisalabad - Pakistan

Sensory Perception of Different Age Groups to Apple Juice

Shereen Gul, ¹Mujeeb-ur-Rahman and ¹Mohammad Zahoor-ul-Haq

Department of Botany, Government Girls College, Quetta, Balochistan, Pakistan

¹PCSIR Laboratories, P.O. Box 387, Mastung Road, Quetta, Balochistan, Pakistan

Abstract: Sensory perception of 81 individuals of different age groups, adolescent (12-18 years), young adults (19-34), adults (35-49) and older adults (50-58 years) to apple juice was investigated. The subjects rated the juice for pleasantness, perceived sweetness, sourness and flavour intensity on a five points category scale. The studies showed that adolescent and older adults were less sensitive to sweetness of sucrose and had higher optimal sucrose concentration than other age groups. The slope for psychophysical function of sweetness decreased from adolescent to older adults. The slopes for sourness were somewhat flattened for young adults and adults than adolescent and older adults. The slopes of psychophysical function of apple flavour were not quite different for all the age groups.

Key words: Sensory perception, apple juice, perceived sweetness, sourness, apple flavour, psychophysical function

Introduction

It is well known fact that age affects the sensory perception and pleasantness of taste and odour of foods (Weiffenbach *et al.*, 1986; Doty *et al.*, 1984; De Graff *et al.*, 1994). Different workers have reported the studies on sensory perception of individuals of various ages (Rovee *et al.*, 1975; Stein *et al.*, 1994).

Studies show that the sense of smell is more affected by age than the sense of taste between young adults and elder people. The elder subjects showed higher concentration of pleasantness of testants and odourants (Murphy, 1983; Cains *et al.*, 1990, De Graff *et al.*, 1996).

The children are less sensitive to taste and odour than adults. Doty *et al.* (1984) found that odour identification ability is lower in age group 5-9 years as compared with age group of 20-99 years. Kimmel *et al.* (1994) concluded that 5-8 years old children were less able to discriminate between different sucrose solutions whereas, Enns *et al.* (1979) suggested that children had steeper psychophysical sucrose function slopes than adults and elderly subjects. Rovee *et al.* (1975) found no difference in olfactory acuity between age groups ranging from 6-94 years. According to Desor and Beauchamp (1987) the children have different hedonic response profiles than adults to pleasantness and they prefer higher concentration of sucrose than adults. Conversely, saltiness is aversive or neutral to infants, but in older children a pattern closer to that of adults develops (Desor *et al.*, 1975). The hedonic response of children to sour or bitter are less clear but seems to be more negative than those of adults (Beauchamp *et al.*, 1991; Lowenberg, 1948).

The present study was designed to determine the age related effects on sensory perception and pleasantness of apple juice.

Materials and Methods

Subjects: The present studies involved healthy subjects divided into four groups: adolescents, young adults, adults and older adults. The age, height, weight and men/women (number) of different group subjects were determined (Table 1). Individuals who had diabetes mellitus were not accepted for study. Non of the subjects had obstructions of nasal cavity. The participants of older adults were taking medicines, which could influence the sense of taste.

Stimuli: The stimuli were 15 different clarified apple juices, prepared and bottled at PCSIR Laboratories, Quetta. They were varied in sugar (3 levels), citric acid (5 levels) and flavour (5 levels) (Table 2).

Procedure: All the subjects were instructed both verbally and in writing to rate the pleasantness, perceived sweetness intensity and sourness intensity on a five point category scale. The pleasantness was measured with a hedonic scale (Watts *et al.*,

Table 1: Characteristics of the subjects classified by age group

Parameters	Age groups			
	Adolescent (12)	Young adults (22)	Adults (29)	Older adults (18)
Age (Years)	14.00 ± 2	24.00 ± 5	43.00 ± 5	55.00 ± 3
Height (cm)	153.00 ± 6	165.00 ± 8	162.00 ± 8	160.00 ± 5
Weight (Kg)	50.60 ± 7	62.76 ± 3	68.50 ± 5	70.25 ± 7
Men/Women (n)	5/7	10/12	14/15	10/8

Table 2: Composition of juices

Juice No.	Total Sugars (Brix, %)	Citric Acid (% w/v)	Flavour (ppm)
1	11.50	0.15	20
2	11.50	0.25	40
3	11.50	0.35	60
4	11.50	0.55	80
5	11.50	0.75	100
6	13.65	0.15	20
7	13.65	0.25	40
8	13.65	0.35	60
9	13.65	0.55	80
10	13.65	0.75	100
11	17.72	0.15	20
12	17.72	0.25	40
13	17.72	0.35	60
14	17.72	0.55	80
15	17.72	0.75	100

1989) where faces were used to indicate the different degrees of like/dislike. The response scale for sweetness, sourness and apple flavour intensity ranges from 'not at all sweet', 'not at all sour' and 'no apple flavour' on the left hand side to 'very strong flavour', 'very sour' and 'very sweet' on right hand side.

The juices were presented to the subjects one by one. A randomized complete block design was used for the order of presentation (Table 2). The time of presentation between the two stimuli was about 60 seconds with a ten minutes rest after a session of five juices.

Juice bottles were refrigerated overnight and opened just before the sensory test. The juice was served in a volume of 30 ml at room temperature in glass cup of 100 ml volume. The instructions (Elizabeth and De Graff, 1998) were to:

- Rinse with water before each stimulus
- Sip from 30 ml and swallow
- Sip again and spit
- Rate the juice on pleasantness and intensity.

Statistical analysis: Analysis of variance was used to determine the difference in pleasantness and intensity using a model with concentration, age group and subjects nested into age group as

main effects. The value of $p < 0.05$ was used as criterion for statistical significance. All data analyses were performed with a SAS statistical software package (Anonymous, 1989 and 1990).

Results

Pleasantness of juices: The mean pleasantness response of different age groups to the juice (Fig. 1) shows that there was a significant age effect related to the pleasantness of the juice ($p < 0.001$). The statistical analyses show that the pleasantness response was higher in adolescent group and lower in adults group of subjects. There was a significant difference in the ranking of pleasantness between the stimuli and the age of the subjects. The most preferred juice differed by group. Adolescent and older adults preferred juice with high concentration of sucrose, medium flavour and medium citric acid whereas, young adults and adults preferred medium concentration of sucrose, medium to high citric acid and high flavour. The adolescent group preferred juice no. 12 and 13 with an average pleasantness of 3.88 and 3.95. The young

adults and adults preferred juice no. 9 with an average pleasantness of 3.25 and 3.5. The older adults preferred juice no. 13 with mean pleasantness of 3.1.

The hedonic response decreased with the age of the subject. The standard deviation, for the 15 different stimuli were respectively 0.55, 0.43, 0.47 and 0.22, ranging from adolescent to older adults. The adolescent, young adults and adults had distinct pleasantness rating in a pronounced manner compared with the older adults, who seemed to be less outspoken in their response.

Concentration – pleasantness function: The mean pleasantness responses of the age groups as a function of sucrose, citric acid and apple flavour (Fig. 2) showed that the overall average responses for sucrose, citric acid and apple flavour were higher for adolescent group of subjects than other age groups. The main concentration effect on pleasantness was significant at $p < 0.001$. The optimal citric acid concentration for different groups was between 0.25 and 0.55 %. Adolescent and older adults had a sharper decrease in pleasantness at higher concentration of citric

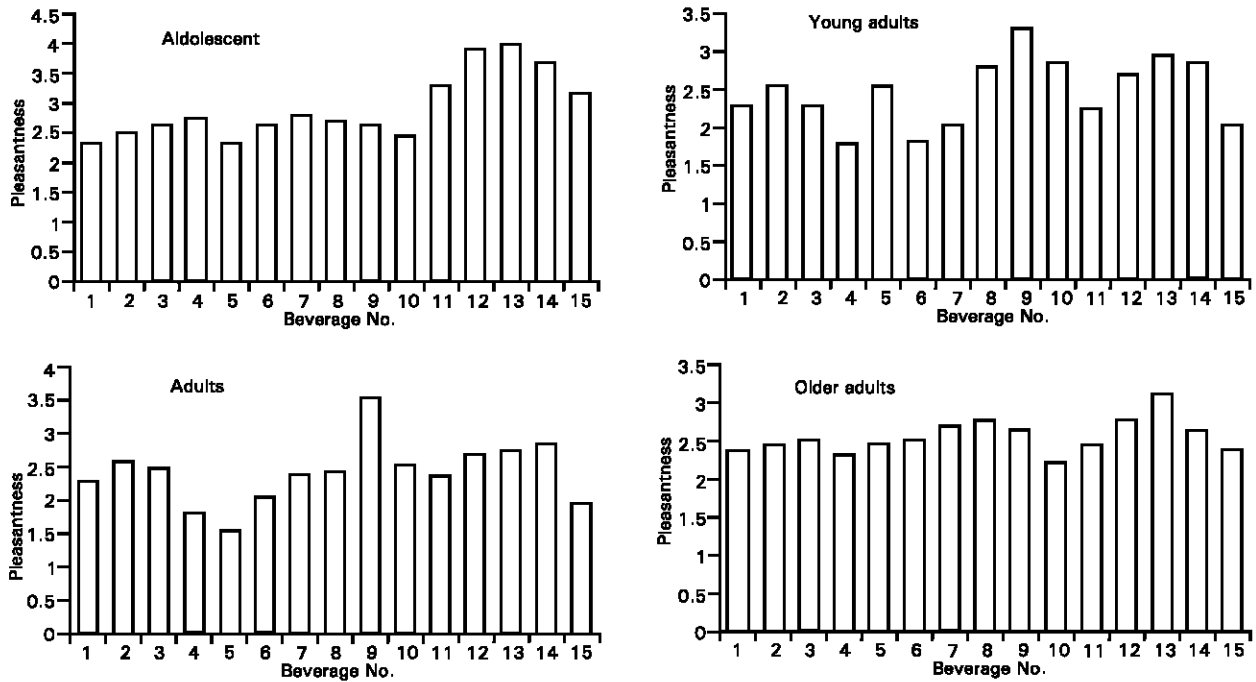


Fig. 1: Pleasantness response to apple juice by the individuals of different age groups

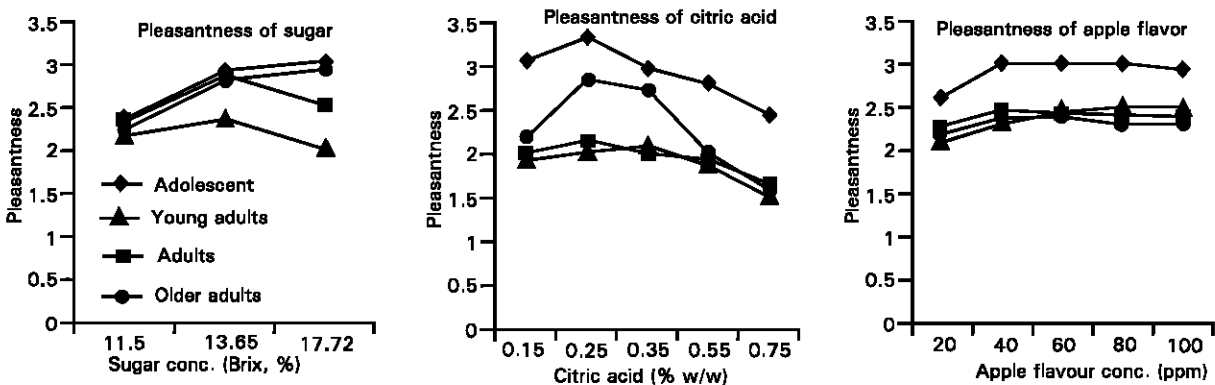


Fig. 2: Pleasantness response of different age groups as a function of relative concentration of sugar, citric acid and flavour in apple juice

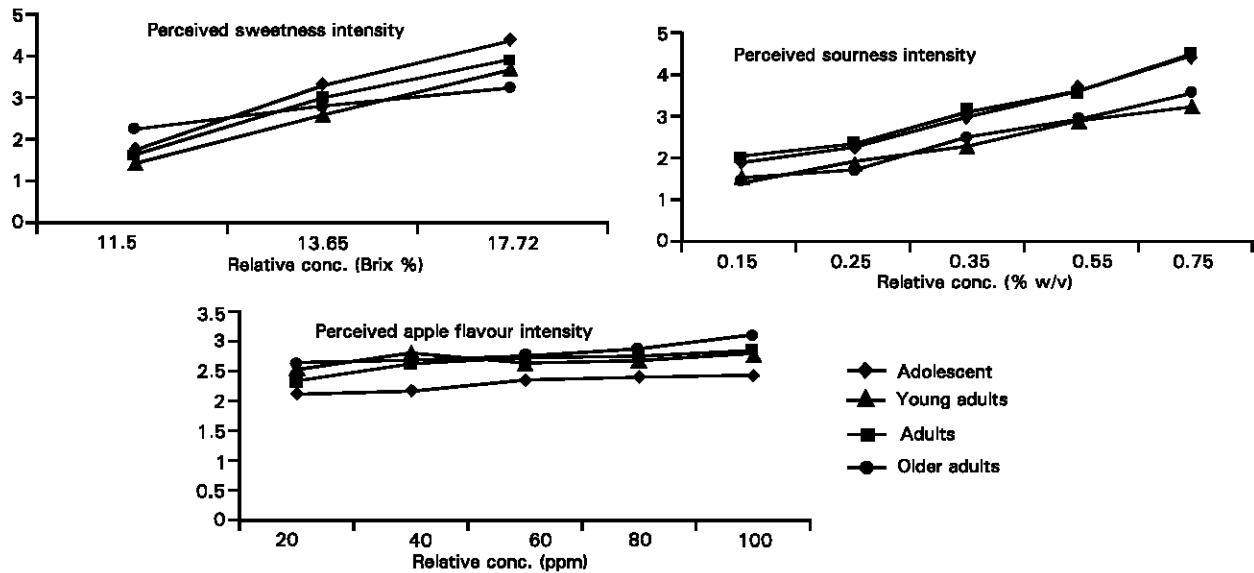


Fig. 3: Pleasantness response of different age groups as a function of perceived intensity of sugar, citric acid and flavour in apple juice

acid compared with other groups ($p < 0.01$).

The optimal concentrations of flavour were less clear. The slope of pleasantness functions for apple flavour showed little difference for the different age groups ($P > 0.05$). The curves of pleasantness function of sucrose were more or less the same for adolescent and older adults ($p > 0.05$). There were pronounced decrease in pleasantness function after optimum concentration of sucrose in case of young adults and adults.

Concentration-intensity function: The effect of concentration on perceived intensity was highly significant for sucrose, citric acid and apple flavour ($p < 0.001$) (Fig. 3). The age effect was also significant for the perceived intensity of sucrose, citric acid and apple flavour ($p < 0.01$). The slope of the psychophysical function of sucrose decreased with the age group from adolescent to older adults. The slopes for sourness were somewhat flattened for adults and older adults than adolescent and younger adults, which was confirmed by a significant age group-concentration interaction ($p < 0.001$).

The slopes of the psychophysical function of apple flavour were not quite different for all the age groups ($p > 0.05$). The average response to perceived intensity of apple flavour was higher in older adults, young adults and adults than adolescents (Fig. 3). The slopes for the psychophysical response were positive for all the age groups.

Discussion

The present study showed that the age affects the sensory perception, pleasantness of taste and odour substances. The adolescents and older adults were less sensitive to sucrose and therefore, have higher optimal sucrose concentration than younger adults. The disliking of sucrose decreased with the increasing age but up to some extent, which was accompanied by a lower slope of psychophysical function of citric acid.

The adolescents had very high slope of psychophysical function of sucrose as compared with adults. These results contradict the findings of Kimmel *et al.* (1994) and Hermel *et al.* (1970) who reported that lower age group individuals are less able to discriminate between sucrose solutions than adults. However, Enns *et al.* (1979) found steeper psychophysical function for sucrose in case of children but no difference in adults. Kimmel *et al.* (1994) and Kroll (1990) found that children are capable of

performing direct scaling task like adults when instructed properly. The psychophysical function of sourness for all the age groups was more or less similar. These results are in line with Chauhan and Haurysh (1988) but not with Cain *et al.* (1990), Weiffenbach *et al.* (1986) and Bartoshuk *et al.* (1986) who reported that older subjects perceived the higher concentration of citric acid as less intense than younger age groups. The flattened slopes of the perceived intensity of sucrose and citric acid by increasing age reflected an age related taste loss.

The average responses of the perceived apple flavour intensity were higher for older adults and lower for adolescent subjects. This may be due to the increase in olfactory acuity with the increase in age. These results are in contradiction of Elizabeth and Graff (1998) who reported the average responses of the perceived apple flavour intensity were lower for oldest age groups than younger groups.

Mean pleasantness responses to the juices were higher for adolescent than for other groups. The mean pleasantness responses for different groups other than adolescent were below 2.55. The low consumption of juices in daily life by older subjects and their unfamiliarity with this kind of soft drink contribute to this outcome.

In the present studies, adolescent and older adults preferred higher concentration of sucrose than the other groups. According to Klesges *et al.* (1991) lower age groups tend to prefer sweeter foods than adults. A preference for sweetness present from birth in children and it is seen that there is a shift in late adolescence towards a reduced preference for sweetness (Desor and Beauchamp, 1987; Beauchamp *et al.*, 1991). The innate preference for sweetness in human probably because of the fact that in nature sweetness often predicts energy value (Rozin, 1990), which is needed for growth. The elderly people preferred high sucrose concentrations because of the decrease in taste and odour perception.

It can be safely concluded from the present studies that adolescent and older adults preferred juices of higher optimal value of sucrose with medium sourness and flavour. The young adults and adults have a preference towards medium sweetness and higher concentrations of citric acid and flavour.

References

Bartoshuk, L.M., B. Rifkin, L.E. Marks and P. Bars, 1986. Taste and aging. *J. Gerontol.*, 41: 51-57.

Gul *et al.*: Sensory perception to apple juice

- Beauchamp, G.K., B.J. Cowart and H.J. Schmidt, 1991. Development of chemosensory sensitivity and preference. In: Smell and taste in health and disease. T.V. Getchell, R.L. Doty, M. Bartoshuk, J. B. Snow, (Eds). Raven Press, New York, pp: 405-416.
- Cains, W.S., F. Reid and J.C. Stevens, 1990. Missing ingredients: Aging and discrimination of flavour. *J. Nutrition for the Elderly*, 9: 3-15.
- Chauhan, J. and Z.J. Hawrysh, 1988. Supra threshold sour taste intensity and pleasantness perception with age. *Physiol. Behav.*, 43: 601-607.
- De Graff, C., P. Polet and W.A. Van Staveren, 1994. Sensory perception and pleasantness of food flavours in elderly subjects. *J. Gerontol. Psychol. Sci.*, 49: 93-99.
- De Graff, C., W.A. Van Staveren and J. Burema, 1996. Psychophysical and psychohedonic functions of four common food flavours in elderly subjects. *Chemical Senses*, 21: 293-302.
- Desor, J.A. and G.K. Beauchamp, 1987. Longitudinal changes in sweet and salty in 9 to 15 years old and adult humans. *Science*, 190: 686-687.
- Doty, R.L., P. Shaman, S.L. Applebaum, R. Giberson, L. Siksorski and L. Rosenberg, 1984. Smell identification ability: changes with age. *Science*, 226: 1441-1443.
- Elizabeth H.Z. and C. De Graff, 1998. Sensory perception and pleasantness of orange beverages from childhood to old age. *Food Quality and Preference*, 9: 5-12.
- Enns, M.P., T.B. Van Itallie and J.A. Grinker, 1979. Contributions of age, sex and degree of fatness on preferences and magnitude of estimations for sucrose in humans. *Physiol. Behav.*, 22: 999-1003.
- Hermel, J., S.V. Schönwetter and S. Samueloff, 1970. Taste sensation and age in man. *J. Oral Med.*, 25: 39-42.
- Kimmel, S.A., M. Sigman-Grant and J. Guinard, 1994. Sensory testing with young children. *Food Technol.*, 48: 92-99.
- Klesges, R.C., R.J. Stein, L.H. Eck, T.R. Isbell and L.M. Klesges, 1991. Parental influence on food selection in young children and its relationships to childhood obesity. *J. American Dietetic Assoc.*, 24: 430-434.
- Kroll, B.J., 1990. Evaluating rating scales for sensory testing with children. *Food Technol.*, 44: 78-86.
- Lowenberg, M.E., 1948. Food preferences of young children. *J. American Dietetic Association*, 24: 430-434.
- Murphy, C., 1983. Age related effects on the thresholds, psychophysical functions and pleasantness of menthol. *J. Gerontol.*, 38: 217-222.
- Rovee, C.K., R.Y. Cohen and W. Shlapack, 1975. Life-span stability in olfactory sensitivity. *Develop. Psychol.*, 11: 311-318.
- Rozin, P., 1990. Acquisition of stable food preferences. *Nutrition Reviews*, 48: 106-113.
- SAS Institute Inc., 1989. SAS procedure guide, Version 6, 3rd ed. SAS institute Inc., Cary, NC.
- SAS Institute Inc., 1990. SAS/STAT User's Guide, Vols. 1 and 2, Version 6, 4th ed. SAS institute Inc., Cary, NC.
- Stein, N., D.G. Laing and I. Hutchinson, 1994. Topographical differences in sweetness sensitivity in the peripheral gustatory system of adults and children. *Developmental Brain Research*, 82: 286-292.
- Watts, B.M., G.L. Ylimaki, L.E. Jeffery and L.G. Elias, 1989. Sensory methods for food evaluation, International Development Research Centre, Ottawa, Ontario, Canada.
- Weiffenbach, J.M., B.J. Cowart and B.J. Baum, 1986. Taste intensity perception in aging. *J. Gerontol.*, 41: 460-468.