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1 April 1975; revised 17 June 1975

Preferences for Sweet and Salty in 9- to 15-Year-Old and Adult Humans

Abstract. *Preferences for the tastes of sucrose, lactose, and sodium chloride were measured in 618 subjects between 9 and 15 years of age and in 140 adults. The younger subjects preferred greater sweetness and saltiness than did the adults. In the younger group, there were race and sex differences in preferences, none of which appeared among the adults.*

Factors controlling the consumption of sugar and salt are of current general interest. Sucrose and sodium chloride are responsible for most of the sweetness and virtually all of the saltiness of the foods making up the current human diet. Individuals vary widely in their preferences for sweetness and saltiness (*1*). The individual's preferences persist over a relatively long period of time (*2*), which suggests that they are characteristic of the person rather than of his immediate metabolic state. These taste preferences may be the major factor mediating the amounts of sucrose and sodium chloride consumed.

In an earlier study, we found sex and race differences in preferences for sweet and salty among 9- to 15-year-old subjects (*2*). Now we find that those between 9 and 15 years of age differ from adults in their preferences for these two taste qualities.

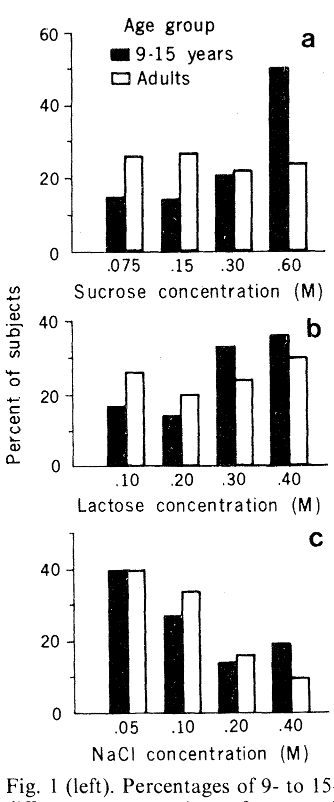
A group of 140 adults (*3*) was tested in a manner identical to that used with the 9- to 15-year-old subjects in the earlier study (*2*). Each subject was given preference tests for sucrose, lactose, and sodium chloride, in that order. For each test, four cups containing different concentrations of the compound were presented. The concentrations were 0.075, 0.15, 0.30, and 0.60*M* sucrose; 0.10, 0.20, 0.30, and 0.40*M* lactose; and 0.05, 0.10, 0.20, and 0.40*M* sodium chloride (*4*). The subject tasted the four samples without swallowing them, and then ranked them in the order of preference from most to least preferred.

The percentage of subjects in each age group (*5*) selecting each concentration as their most preferred is given in Fig. 1. In the case of sucrose, approximately one-fourth of the adults selected each of the concentrations as his most preferred, whereas 50 percent of the children selected the most concentrated sample as the one they like the best ($\chi^2 = 27.1$, d.f. = 3, $P < .01$). The same pattern appeared with lactose ($\chi^2 = 12.0$, d.f. = 3, $P < .01$), although it was not so pronounced with this less sweet and less acceptable (*6*) sugar. This age difference in preference for sweetness correlates with recent U.S. Department of Agriculture estimates of sugar consumption: a 1965 survey indicates that the per capita consumption of sugar and sweets is greater among those 9 to 15 years of age than among adults (*7*).

The two age groups also differed in their salt preferences ($\chi^2 = 8.3$, d.f. = 3, $P < .05$). The largest percentages of both groups indicated that they most preferred the mildest salt solution, but among the younger subjects, there was a relatively large group that selected the saltiest sample. Thus, for all three of these compounds, more 9- to 15-year-old subjects than adults preferred the more concentrated solutions (*8*).

These first-choice preference data were analyzed further for effects of sex and race. Among those 9 to 15 years of age, males selected sweeter lactose solutions than did females ($\chi^2 = 8.5$, d.f. = 3, $P < .05$). Although the differences were not statistically significant, there were trends in this direction among the adults and among both age groups for sucrose. This observation also conforms to intake estimates in the United States: after age 9, males consume greater quantities of sweets than do females of the same age (*7*). No sex differences appeared in either group for salt preferences.

The distribution of first choices among the black and white subjects in the two age groups are given in Fig. 2. In the younger group, more of the black than the white subjects selected stronger concentrations of sucrose ($\chi^2 = 17.1$, d.f. = 3, $P < .01$), lactose ($\chi^2 = 10.6$, d.f. = 3, $P < .05$), and sodium chloride ($\chi^2 = 67.4$, d.f. = 3, $P < .01$) as their most preferred. None of



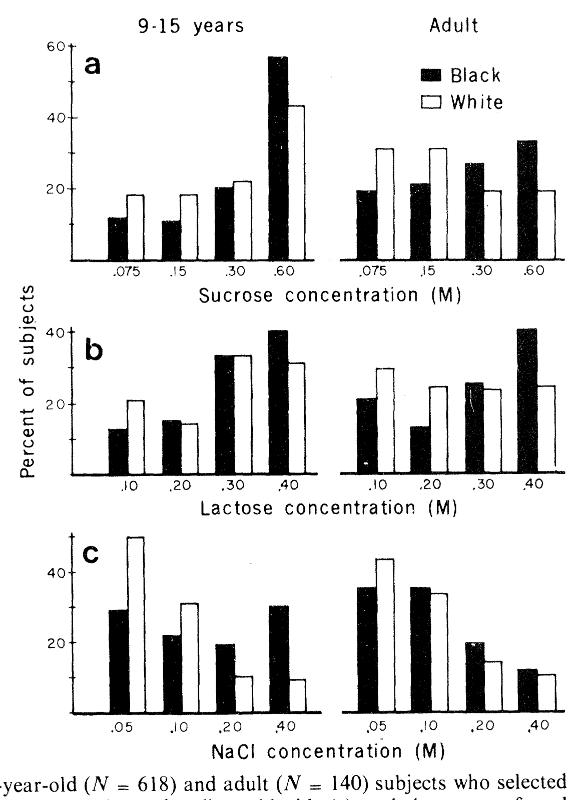


Fig. 1 (left). Percentages of 9- to 15-year-old ($N = 618$) and adult ($N = 140$) subjects who selected different concentrations of sucrose (a), lactose (b), and sodium chloride (c) as their most preferred concentration. Fig. 2 (right). Percentages of 9- to 15-year-old blacks ($N = 310$) and whites ($N = 308$) and adult blacks ($N = 52$) and whites ($N = 88$) who selected different concentrations of sucrose (a), lactose (b), and sodium chloride (c) as their most preferred concentration.

these differences appeared among the adults, although there were tendencies for black adults to select stronger solutions than selected by white adults (Fig. 2). Race differences in preferences for sweet and salty might be observed among adults if larger samples are tested.

The younger black subjects differed markedly from the other groups in their preference for salt. Only a small percentage of the white adults, black adults, and white 9- to 15-year-old subjects (10, 12, and 9 percent, respectively) demonstrated a preference for the highest concentration of salt, whereas 30 percent of the younger blacks preferred the saltiest sample. High salt intake, particularly early in life, has been related to the development of essential hypertension (*9*). The incidence of hypertension is greater among blacks than among whites in the United States (*10*). This difference in the incidence of hypertension, rather than reflecting a genetic difference in susceptibility, may be due to dietary differences in amount and pattern (or both) of salt intake early in life. Those 9- to 15-year-old subjects with a preference for the taste of highly concentrated salt may select a diet that is high in salt, thereby disposing themselves to hypertension.

The differences described make it clear that human populations are not homogeneous in their preferences for sweetness and saltiness. Although there is considerable evidence that the human species has evolved with a preference for sweet, evidenced even in newborns (*11*), there are individual and population differences in the degree of sweetness preferred. The observed differences in preferences for sweetness and saltiness may reflect differences in caloric needs and requirements for sodium chloride. Alternatively, they may reflect differences in experience and learned dietary preferences, which may or may not correspond to optimum nutritional practices.

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3. This group (ages 18 to 64) included 92 males and 48 females; 52 were blacks, and 88 were whites.
4. All test solutions were made with deionized water and reagent grade chemicals. They were given in 30-ml samples and were at room temperature. The order in which the concentrations were sampled was varied. Rinse water was available throughout. The subject was required to rinse his mouth thoroughly before beginning the sucrose test and during 1-minute rest periods between successive tests.
5. The data for younger subjects used in these comparisons are the first choices of 618 subjects ranging from 9 to 15 years of age. There were 318 males and 300 females in the group. Racially, 310 were black and 308 were white (*2*).
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3 March 1975; revised 2 July 1975

Molluscan Gastrin: Concentration and Molecular Forms

Abstract. *Blood and gastrointestinal tissues of the sea hare* Aplysia californica *and the land snail* Otala lactea *contain immunoreactive gastrin in heterogeneous forms similar to those of mammals. The observation that blood concentrations in terms of a porcine gastrin standard are comparable to those of pig, man, and dog suggests significant homology between the structures of molluscan and mammalian gastrins.*

Current interest in the origin and evolution of the peptide hormones reflects the premise that a phylogenetic approach will provide new insight into their complex physiologic interrelationships and better understanding of the heterogeneity of their molecular forms. Theoretical proposals, for example, have related specific or hypothetical gastrointestinal peptides to proinsulin as evolutionary descendants and antecedents (*1*). However, a more précise picture of the development of the mammalian gastrointestinal peptide hormones awaits information concerning their presence in lower phyla. We now report the presence and molecular heterogeneity of immunoreactive gastrin in two molluscan species.

Gastrointestinal tracts from *Aplysia californica* and from active and aestivating *Otala lactea* were removed, and gastrin was extracted in ten volumes of boiling water. Extracts from the remaining portions of the animals were obtained similarly. The tissue extracts and blood that were collected from the animals were stored at –20°C prior to use. The blood samples in final dilutions of 1 : 250, 1 : 100, 1 : 50, and 1 : 25 were examined for gastrin by radioimmunoassay techniques (*2*). Amounts of the hormone are expressed as the mass content immunochemically equivalent to the stated mass of natural porcine heptadecapeptide gastrin (HG) used as standard. Samples of blood and tissue extracts were fractionated by gel chromatography on Sephadex G-50 fine columns (1 by 50 cm) (*3*).

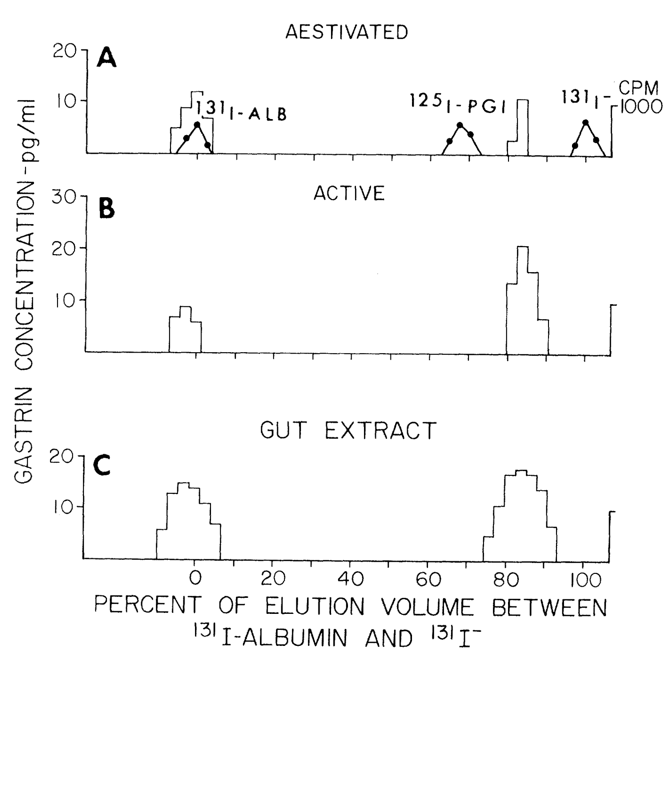

Fig. 1. Sephadex G-50 gel filtration of immunoreactive gastrin in the blood of the aestivated (A) and active (B) *Otala lactea* and in the gut extract (C) of the active *Otala*. ^{131}I-albumin and ^{131}I$^-$ were added to samples before application to the column to mark the void volume and salt peak respectively. The elution volume of ^{125}I-labeled porcine gastrin I (PGI) is also shown.