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Molecular variants associated with flavor perceptions and ancestral proportions of Ecuadorian populations

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ABSTRACT

The perception of taste is determined by several factors, including genetics, which at the same time is related with the diet and diseases in different populations. We aimed to identify the frequency of six single nucleotide polymorphisms (rs307355, rs35744813, rs713598, rs1726866, rs10246939 and rs11091046) involved in the perception of sweet, bitter and salty flavor in Ecuadorian mestizo population. It was found that the presence of the T allele of rs307355 and rs35744813 is associated with decreased ability of subjects to carry out specific discrimination of sweetness, this is particularly interesting given the correlation found ($p = 0.0022$) between sucrose perception and family history of cancer and diabetes. Furthermore, rs713598, rs1726866 and rs10246939 do not influence the ability to perceive the bitter taste. Concerning the perception of the salty taste, rs11091046 does influence the capacity of detecting it more easily. This theoretical knowledge of the genetic influence on taste perception can contribute to the understanding of eating habits and their impact on human health.

1. Introduction

The taste sensation is produced in receptor proteins that recognize ligands belonging to the five types of tastes: salty, sweet, sour, bitter and umami. Sweet taste receptors are neuroepithelial cells in the taste buds, arranged on the surface of the tongue [1]. How sensitive a population is to certain flavors is reflected in their diet and the same time correlated to nutritional disorders such as overweight and obesity, representing a risk factor for diabetes, cardiovascular disease, cancer, premature death, etc. [2]. Thus, the aim of this study was to evaluate the frequencies of certain polymorphisms which make us more or less sensitive to sweet, bitter, and salty flavors in Ecuadorian mestizo individuals ($n = 110$). The umami taste was already discussed in Paz-y-Miño et al. [3].

2. Materials and methods

2.1. Participants and samples

A total of 110 healthy Ecuadorian mestizo individuals between the ages of 17 and 62 were included in the study. Once the participants signed the informed consent, blood samples were collected as well as additional parameters such as age, sex, and clinical history.

2.2. Threshold taste evaluation

To determine the threshold taste of participants we conducted a test at different concentrations depicted on Table 1. The dilutions were classified from levels 1 to 5, being 1 undetectable, 2 weak, 3 moderate, 4 strong and 5 very strong.

2.3. Genotyping

DNA was extracted from peripheral blood samples using the PureLinkT Genomic DNA Kit (Invitrogen, Carlsbad, CA) followed by DNA quantification using NanoDrop 2000 (ThermoScientific, Waltham, MA). Genotypes for the six SNPs (rs307355, rs35744813, rs713598, rs1726866, rs10246939 and rs11091046) were determined using PCR and sequencing by conditions detailed in Paz-y-Miño et al. [3].

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Table 1
Threshold and taster types of each flavor.

Taster	Flavors Concentrations		
	Bitter (Sodium benzoate)	Salty (Sodium Chloride)	Sweet (Sucrose)
Undetectable	0.001	0.02	0.05
Weak	0.08	0.05	0.1
Moderate	0.25	0.1	0.4
Strong	0.4	0.5	0.5
Very Strong	0.75	1	1

Table 2
Distribution and genotypic frequencies of polymorphic variants.

Genes	Taste	Polymorphisms	Alleles	n
TAS1R3	Sweet	rs35744813	C/C	76
			C/T	29
			T/T	5
		rs307355	C/C	79
			C/T	27
			T/T	4
TAS2R38	Bitter	rs713598	C/C	66
			C/G	38
			G/G	6
		rs1726866	C/C	69
			C/T	36
			T/T	5
		rs10246939	G/G	66
			G/A	39
			A/A	5
AT2	Salty	rs11091046	C/C	32
			C/A	31
			A/A	47

2.4. Genetic ancestry determination

The population was genotyped by multiplex reaction using 46 autosomal ancestry informative insertion deletion markers (AIM-INDELs) described by Pereira et al. [4]. Fluorescent DNA fragments were sequenced by capillary electrophoresis in the Genetic Analyzer ABI 3130 (Applied Biosystems, Austin, TX) and were identified using the software GeneMapper v3.1 (Life Technologies, Carlsbad, CA).

2.5. Statistical analysis

Descriptive statistical analysis was used. Allelic and genotypic frequencies of each SNP were used to calculate genotype information, and Hardy-Weinberg Equilibrium (HWE) was determined. To find statistically significant relationships between frequencies, the Fisher statistic exact test was applied (expected frequencies below 5).

3. Results

3.1. Participant´s demographics and characteristics

Women composed 59.10% and men 40.90% of the group. The genotypes are shown in Table 2.

3.2. Genetic ancestry determination

The participants involved in this study were the same used in Paz-y-Miño et al. [3].

3.3. Sweet

The polymorphism rs307355 has the lowest frequency and no statistical significance was found. However, rs35744813 was correlated ($p < 0.001$) with perception of sucrose at 1%. Furthermore, T allele of rs307355 and rs35744813 was associated with decreased ability of discrimination of sweetness [5,6]. In this study we found a between family medical records and their perception of sucrose ($p = 0.022$).

3.4. Bitter

The rs713598 rs1726866 rs10246939 did not influence the ability to perceive the bitter taste, however we found difference between women and men and their ability to detect bitterness in the lowest concentration (0.001%, $p = 0.040$), which was also related to alcohol consumption ($p = 0.02$).

3.5. Salty

Individuals with rs11091046 polymorphism required very strong concentrations of sodium chloride. Amongst the Ecuadorians, there was a statistical significance for the genotypes C/C at 0.5% ($p < 0.05$) and 1.0% ($p < 0.05$). This established the fact that the rs11091046 polymorphism influenced the ability to detect saltiness [7,8].

4. Discussion

Different populations express different variants of *TAS1R3, TAS2R38* and *AT2* genes, giving their ethnicity. Ecuadorians is a three hybrid population with European (33%), African (13%) and Native American (51%) components [7]. These variants may come from these ancestral genetic components, increasing the variability of flavor sensibility among Ecuadorians.

5. Conclusion

This variation had dictated the sensitivity to perceive flavors in the food Ecuadorian mestizo population consume. These polymorphisms may influence a population's food preferences, diet, nutritional status, personal habits, and health risks [3,9].

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Declaration of Competing Interest

None.

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