Alcohol-evoked drinking sensations differ among people as a function of genetic variation

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Taste strongly influences food and beverage intake, including alcohol. Furthermore, genetic variation in chemosensory genes can explain variability in individual perception of and preference for alcoholic drinks. A new study has examined the relationship between variation in alcohol-related sensations and polymorphisms in bitter taste receptors genes previously linked to alcohol intake, and for the first time, polymorphisms in a burn receptor gene. The findings indicate that genetic variations in taste receptors influence intensity perceptions.

Results will be published in the October 2014 online-only issue of *Alcoholism: Clinical & Experimental Research* and are currently available at Early View.

"People may differ in the sensations they experience from a food or beverage," explained John E. Hayes, assistant professor of food science as well as director of the Sensory Evaluation Center at The Pennsylvania State University. "And like color blindness, these perceptual differences have a biological basis. Prior work shows that some people experience more bitterness and less sweetness from alcoholic beverages like beer. In general, greater bitterness relates to lower liking, and because we generally tend to avoid eating or drinking things we don't like, lower liking for alcohol beverages associates with lower intake." Hayes is also the corresponding author for the study.

"The link between genetic variations in receptors and taste is an area of growing importance," noted Russell Keast, a professor of sensory and food sciences at Deakin University in Australia. "Variations in bitter taste may be particularly important because previous research has shown people who experience bitterness as more intense consume less bitter vegetables. However, it does get more complex because alcoholic beverages contain flavours and tastes that may mask any aversive effects of bitterness – for example, the sweetness of a sherry, or the aromas of a cocktail."

"We picked the two bitter receptor genes – taste receptors type 2 member 13 (TAS2R13) and type 2 member 38 (TAS2R38) because both had previously been linked to differential alcohol intake," said Hayes. "In contrast, variation in the burn receptor gene – transient receptor potential vanilloid receptor 1(TRPV1) – has not previously been linked to differences in intake, but we reasoned that this gene might be important as alcohol causes burning sensations in addition to bitterness."

Hayes and his colleagues genotyped 93 Caucasian participants (58 women, 35 men), 18 to 45 years of age, for 16 single nucleotide polymorphisms (SNPs) – a DNA sequence variation occurring commonly within a population – in TRPV1, three SNPs in TAS2R38, and one SNP in TAS2R13. Participants then rated alcohol samples presented in two ways: one, a 16-percent alcohol whole-mouth, sip-and-spit solution with a single time-point rating of overall intensity; and two, a cotton swab saturated with 50 percent alcohol and placed on the back of the tongue, with repeated ratings made during three minutes.

"Ours is the first study to show that the sensations from sampled alcohol vary as a function of genetics," said Hayes. "The present data are wholly consistent with prior speculation that taste-gene variants and alcohol intake are associated due to perceptual differences that influence liking. Our study was also the first to consider whether variation in the burn

receptor gene TRPV1 might influence alcohol sensations, which has not previously been linked to alcohol intake. More specifically, we showed that when people taste alcohol in the laboratory, the amount of bitterness they experience differs, and these differences are related to which version of a bitter receptor gene the individual has. We also found that burning sensations may likewise differ with different versions of TRPV1."

"While the identification of SNPs associated with bitterness of alcohol is the key finding," said Keast, "the potential implications regarding excess alcohol consumption are perhaps more important. However, those implications may be difficult to disentangle given the complexity of behaviours associated with dietary intake. Evidence is slowly emerging that taste receptor variation may influence dietary intake. While this was not assessed in the current study, the implications are that a person who finds a food particularly bitter will dislike that food and not consume it. Therefore this study provides some insight into a possible reason why some people may avoid alcohol."

Hayes agreed. "People differ in their food sensations and this influences what we like," he said. "That is, not everyone starts from the same blank slate when it comes time to learn to like a specific food or beverage. Accordingly, it may be easier for some people to learn to like to eat or drink a certain food and beverage, including alcohol. However, other factors such as learning, prior experience, and the environment also play a huge role in our preferences and the choices we make."

Hayes added that it is unlikely that chemosensory variation plays a role in predicting alcohol intake once an individual becomes dependent. "However, genetic variation in chemosensation may be underappreciated as a risk factor when an individual is initially exposed to alcohol, and is still learning to consume alcohol," he said. "Some have suggested taste genes may act like as a 'stage gate' on other genetic risk factors; if you

never ingest alcohol in the first place because of the taste, metabolic or reward related polymorphisms may be largely irrelevant."

"Thus, the next logical step would be to look at the genetic variations and assess if these alleles predict differences in liking," said Keast.

Nonetheless, both Hayes and Keast noted that genetics does not wholly determine one's drinking fate.

"Biology is not destiny," said Hayes. "That is, food choice remains that, a choice. Some individuals may learn to overcome their innate aversions to bitterness and consume excessive amounts of alcohol, while others who do not experience heightened bitterness may still choose not to consume alcohol for myriad reasons unrelated to taste."

"Just because a genetic variant in a taste receptor is associated with perceived intensity does not mean any more than the two variables are associated," added Keast. "The broader implications come from the thought that bitterness or pungency will influence intake – this may or may not be true. Future research can assess if the variants are linked with intake."

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