

Saliva and Sweet Taste Perception for Phenylthiourea (P.T.C.)

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Introduction

Sweet taste perception for phenylthiourea (P. T. C.) was investigated by Skude (1959) and variation of sweet taste perception were described (Skude 1960 a). The cause of this variation is not known. The variability might be due to differences in the saliva, in the sense organs, or in the nervous system. To solve the first possibility the following experiments¹ were done.

Material and methods

1. The tongue of one consistent sweet taster and of two normal tasters were dried with filter paper and by a current of air and were kept dry by help of a saliva ejector. Test solutions were applied on the dry tongue with the "straw" method (Pasteur pipette). This method is the most convenient when small areas of the tongue are to be tested (Skude 1960 b). Between each test solution the tongue was cleaned with tap water. P. T. C., sucrose, sodium chloride, quinine sulphate and hydro-chloric acid diluted with distilled water were used.

2. The following experiments were performed to study the effects of saliva on phenylthiourea.

Saliva was collected from 12 persons with different taste thresholds for P. T. C. One of the persons was a sweet taster. 10 mg of P. T. C. was dissolved in 10 ml of 90% acetic acid. 250 μ l of this solution was placed in a desiccator and evaporated to dryness. 1 ml of saliva was added to the residue and the tube was placed on a magnet-mixer. For extraction a solvent containing ethylacetate: ethylene chloride: water (3: 1: 4) was prepared. After separation of the phases four extractions were made, the first with 4 ml organic phase and the subsequent three with 2 ml each. The extracts were evaporated to dryness in a stream of nitrogen at 40° C.

The residue was dissolved in 250 μ l of 90% acetic acid and 10 μ l was applied for paper chromatography (Sjöqvist 1960) on a filter paper (Wahman No 1). The paper was pretreated by soaking in a 0.1% aqueous solution of EDTA- disodium sal

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and subsequently dried at 100° C for approximately one hour. Descending paper chromatography was carried out in closed glass tanks. The solvent system was prepared by mixing heptane: ethylene chloride: 75% formic acid (6: 12: 1). After separation the lower phase was discarded. Filter papers on the sides of the chromatographic jar were soaked in the phase, which also covered the bottom of the jar. A filter paper soaked in 75% formic acid was hung into a dish in the bottom of the jar. After application the papers, hung in the jar, were allowed to equilibrate for 15 min. before moving phase was added. The papers were developed for about 3 hours at 24° C and were dried at 100° C for 30 min.

On a fluorescent screen the spots were located with u. v. light (Sjöquist 1960). The spots as well as blanks of corresponding size were cut out. The pieces of paper were eluted in 2 ml ethanol for 1 hour at 40° C and the extinction was read at 265 m μ in a Beckman DU spectrophotometer.

Results

1. In the study of taste reactions by the "straw" method the taste solutions were diluted with equal quantities of distilled water, normal saliva and boiled saliva of the respective persons.

None of these caused any taste sensation immediately after application to a dry tongue but after about 10 seconds a taste sensation appeared, which, however, as a rule was not distinct. The taste sensation appeared sooner if the tongue was rubbed with a glass rod.

When the taste solutions were applied to a naturally wet tongue it was found, in case of the P. T. C. that the weakest concentration was recognized in the region of the vallatae papillae. On the edges of the tongue a solution of the two- or fourfold concentration could be recognized. The solution had to be still more concentrated to give rise to any taste sensation on the tip. The sweet taster reported corresponding conditions. On the vallatae papillae weak concentrations, solutions 13-12 according to Harris and Kalmus (1949), tasted sweet, stronger solutions 11-4 sweet and bitter, the strongest solutions, 3-1, tasted bitter only. The same was reported for the edges of the tongue with the difference, however, that the dilutions tasting sweet, sweet and bitter, and bitter were the solutions 11-4, 3-2 and 1, respectively. On the tip of the tongue only the two strongest solutions were reported to have any taste, this taste was bitter. Besides, bitter taste was reported on the soft palate, in the region of the palato-glossal arches and in the pharynx.

2. In the present investigation it was not possible to detect any influence of saliva on P. T. C. by means of the paper chromatography method. There were no significant differences in the extinction if boiled saliva or distilled water were added to the evaporated acetic acid solutions of P. T. C. instead of normal saliva. Nor was there any difference between the samples of the twelve different persons. The period of time that the saliva was mixed with the evaporated solutions of P. T. C. before the extraction had no effect on the extinction.

Discussion

1. When a drop of the taste solution was placed on a dry tongue it at first was like pouring water on a duck's back, but after some seconds the drop flowed out on the tongue and soon afterwards a taste was perceived. This probably happened when the epithelium was soaked, the soaking coming from the drop on the surface or from the small salivary glands of the tongue or from both. As Hahn and Günther (1932) noted, the taste solution has to flow over the sense field in order to cause a distinct sensation. This phenomenon might help to explain why the taste sensation was more distinct when the tongue was rubbed.

Contradictory statements occur in the literature as to whether a solution of a substance has to be mixed with saliva or not to give rise to taste sensations. Cohen and Ogden (1949) found that a person "must have his own saliva (or presumably, its chemical equivalent)" to taste P. T. C. No person in their series could taste a P. T. C. solution, two thirds failed to taste saccharine and one third failed to taste salt on a dry tongue. Salmon and Blakeslee (1935) wrote that 4 persons of 6 required more concentrated solutions after drying their tongues, the other two had consistent threshold solutions. Biester et al. (1925) in studying relative sweetness of sugars dried the tongue so that the taste solution was not diluted by saliva. Hahn (1932) using a "tast-microscope" rinsed the tongue with flowing water for 15 seconds before each test in order to prevent the solution from being mixed with saliva. In view of the foregoing and the observations made in the present investigation it seems possible that taste sensations may arise in the absence of saliva, except for the secretion from the small glands on the tongue and v. Ebner's glands opening in the gutters between the papillae.

2. Fawcett and Kirkwood (1954) found evidence of a soluble enzyme system, tyrosine iodinase, in the parotid and submaxillary glands. Fischer and Griffin (1959) analyzed the distribution of free iodine in the saliva of thirty children and found it to resemble the distribution of taste blindness to P. T. C. They conclude that variations in taste sensitivity are associated with genetic variations controlling the amount and composition of the soluble enzyme system found by Fawcett and Kirkwood (Fischer and Griffin 1960 a and 1960 b). Wolfe and Turner (1957) studied salivary peroxidase activity, the amount being inversely related to the amount of salivary free iodine (Fischer and Griffin 1960 b).

Bourne (1948) demonstrated alkaline phosphatase in the gustatory and olfactory epithelia in man. Baradi and Bourne (1957) found the papillae foliatae and surrounding tissues of the rabbit to contain a number of enzymes, some enzymes being more concentrated in special sites. Various tasting substances affected the activity of different enzymes in different sites.

These data indicate that enzymes may play an important role in taste. With the method used in the present examinations it was not, however, possible to find any substance in the saliva to have any influence on P. T. C. that could explain the different taste sensations this compound gave rise to in different persons.

Summary

Taste sensations for P. T. C. and the standards might occur when an aqueous solution of a solid is placed on a tongue, free from the saliva of the parotid, sublingual and submaxillary glands, the tongue thus being soaked only by the secretion of v. Ebner's glands and other small glands on the tongue.

A descending paper chromatography method described in the paper failed to reveal any different influence of the saliva from different persons (non-tasters, tasters and a sweet taster) on phenylthiourea.

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RIASSUNTO

Sensazioni di gusto per la feniltiourea (P.T.C.) e gli standard si possono verificare allorchè una soluzione acquosa di un solido viene posta su una lingua priva di saliva proveniente dalle ghiandole parotidi, sublinguali e sottomascellari, dato che la lingua viene irrorata in tal caso solamente dalla secrezione delle ghiandole di

von Ebner e da quelle di altre ghiandole minori situate sulla lingua.

Un metodo cromatografico discendente a carta descritto nell'articolo non è riuscito a dimostrare alcuna differenza di influsso sulla feniltiourea da parte della saliva di soggetti diversi (impercettori di gusto, percettori di gusto ed un percettore di sensazione di dolce).

RÉSUMÉ

Des perceptions d'un goût pour la phénylthiourée (P.T.C.) et les standards peuvent être notés lorsqu'une solution aqueuse d'un solide est posée sur la langue dépourvue de la salive provenant des glandes parotides, sublinguales et sous-maxillaires, la langue ne recevant ainsi que la sécrétion des glandes de von Ebner et d'autres glandes mineures situées sur la langue.

La méthode chromatographique descendante à bandelettes de papier, décrite dans l'article, n'est parvenue à révéler aucune différence dans l'influence produite sur la phénylthiourée par la salive de sujets différents (des percepteurs négatifs, des percepteurs positifs et un percepteur de goût doux).

ZUSAMMENFASSUNG

Geschmackssensationen durch Phenylthiourea (P.T.C.) und die Standards können auftreten, wenn eine wässrige Lösung eines festen Stoffes auf eine Zunge gelegt wird, die vom Speichel der Ohrspeichel —, der Unterzungen — und der Unterkieferdrüsen frei ist, und daher nur von dem Sekret von v. Ebners Drüsen und anderen kleinen Zungendrüsen durchnässt wird.

Bei einem chromatographischen Versuch mit Papierstreifen, der in der Schrift beschrieben wurde, konnte man keinen verschiedenartigen Einfluss des Speichels verschiedener Personen (Nichtschmecker, Schmecker und ein Süßschmecker) auf Phenylthiourea nachweisen.