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Effect of early exposure to sucralose on fluid intake in rats

Efecto de la exposición temprana a la sucralosa sobre el consumo de líquidos en ratas

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Abstract

Experimental evidence has demonstrated the effect of exposure history on feeding behavior in organisms. However, it is reported that sucralose is not adequately consumed by the rats.The aim of this study was to evaluate effect of early exposure to sucralose in subsequent fluid intake in Wistar rats. Twenty rats were assigned into two groups, A and S. The S group was exposed to sucralose from nursing, since her mother drank a solution with sucralose during this stage. Group A was exposed to water. At 90 days of age both groups received a solution with sucralose for 10 days, followed by 10 days in which they returned to initial conditions (A, water and S, sucralose). Later both groups received water for 10 days, ending the experiment with a return to initial conditions for 10 days. The results showed a differential effect in sucralose and water consumption with respect to sex. In particular females consumed more sucralose than males. However, experimental group exposed to it early sucralose showed a higher consumption compared with the group exposed to water. These results showed that exposure to sucralose flavor during lactation influences the fluids habitually consumed by females, also showed differential effects with respect to sex. Animals exposed to sucralose from nursing showed an increase in sucralose consumption after water intake. This evidence demonstrates the role that early exposure to specific flavors in the pattern of consumption in adulthood. Additionally, it is possible to point out the importance of learning at an early age as a tool to prevent the development of food pathologies.

Resumen

La evidencia experimental ha demostrado el efecto de la historia de exposición sobre el comportamiento de alimentación en los organismos. Sin embargo, se ha reportado que la sucralosa no es consumida por las ratas. El objetivo de este trabajo fue evaluar el efecto de la exposición temprana a la sucralosa en el consumo de líquidos de ratas de la cepa Wistar. Veinte ratas de la cepa Wistar se dividieron en dos grupos: A y S. El grupo S, estuvo expuesto a la sucralosa desde la lactancia, ya que su madre tomó una solución con sucralosa en esa etapa. El grupo A estuvo expuesto a agua. A los 90 días de edad ambos grupos recibieron como bebida una solución con sucralosa por 10 días, seguido de 10 días en los que retornaron a condiciones iniciales (A, agua y S, sucralosa). Posteriormente recibieron como bebida agua por 10 días, finalizando el experimento con un retorno a condiciones iniciales por 10 días. Los resultados mostraron un efecto diferencial en el consumo de sucralosa y agua con respecto al género. En particular, las hembras consumieron más sucralosa que los machos. Sin embargo, el grupo experimental expuesto a la sucralosa mostró un consumo más alto en comparación con el grupo expuesto al agua. Estos resultados mostraron que la exposición al sabor de la sucralosa desde la lactancia, influyó en el consumo habitual de líquidos en las hembras. Los animales expuestos a la sucralosa desde la lactancia mostraron un aumento en el consumo de sucralosa después de la ingesta de agua. Esta evidencia demuestra el papel que tiene la exposición temprana a sabores específicos en los patrones de consumo en la edad adulta. Además, es posible señalar la importancia del aprendizaje a una edad temprana como una herramienta para prevenir el desarrollo de patologías alimentarias.

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Introduction

Characteristics of foods such as flavor, smell and texture provide the animals with important information. From these information organisms determines if a food should be consumed or avoided, responding to taste elements based on innate and learned preferences, and also, animals learn to avoid foods with toxic effects and prefer those that provide nutritional benefits (Sclafani, 1990). Many species are genetically predisposed to prefer sweet flavors, since sweet foods are a safe source of energy and nutrients. Therefore, the adaptive evolutionary development has resulted in a preference for sweet foods (Keskitalo et al., 2007). However, even when there is an innate preference to sweet flavor, the contextualization of it occurs and begins to develop as soon as sweet flavor is provided and is experienced (Booth, 1994).

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Several authors have studied the effect of different sweeteners in food and water intake in animal models. Martínez, López-Espinoza, Díaz and Valdés (2009) reported a gradual increase on glucose sweetened solution intake, whereas sucralose solution intake remained stable. Conversely, Kenney and Collier (1976) reported an increase in saccharine consumption in comparison to water intake. When presented simultaneously with a sucrose solution, a saccharine solution, and water, rats consumed twice as much liquid and saccharine solution intake represented 60% of total consumption, sucrose solution 35.3%, and water 4.5%. The authors concluded that saccharine and sucrose solutions are independent to each other and that sucrose solution consumption does not depend only of sweet flavor.

Torres-González et al. (2009) evaluated the effect of stress on water, sucralose solution and glucose solution consumption. As in the water consumption condition, authors did not find any changes in sucralose solution during the exposure to stress compared to no-stress phases, while an increase in glucose solution intake was reported during exposure to stress. Bello and Hajnal (2005) analyzed the effect of water or sucralose consumption on eating behavior of male rats, varying sweetener concentration. Authors reported that at low quantities the rats did not prefer sucralose, whereas at high concentrations they avoided it. On the other hand, Sclafani y Clare (2004) showed bimodal differences in the preference and aversion for sucralose in rats, their reports indicate that about half of the rats preferred sucralose in comparison to water, whereas the rest of them avoided sucralose. These authors pointed out that sucralose seem to be less palatable in comparison to other sweeteners. However, there are modifications in sucralose preference depending on the purity of this sweetener. It has been reported that sucralose combined with maltodextrine (Splenda) increases the palatability of solution and decreases aversion to taste of sweetener (Dess, Chapman y Monroe, 2009).

A common trait among these experimental findings is the use of rats that were not previously exposed to sucralose. However, influence of prior exposure, preferences and aversions to sucralose sweetened drinks has not been sufficiently explored. García and Bach (1999) pointed out that the exposure is one of the most powerful influences to develop most food preferences. To illustrate this connection between exposure and food preference, Beauchamp and Moran (1984) pointed out that two years old children who were fed with sweetened water during the first months of their lives showed a higher preference towards sweetened water when compared to those which had little or no exposure to it.

Nevertheless, two aspects which should be considered in the procedures to exposing the sweetener are age and gender of subjects. Provenza (1994) indicated that age at moment to exposure to foods influences in development of dietary habits in ruminants, there is a sensitive period for learning and development of food preferences which corresponds to weaning. This seems to be biologically reasonable because milk production decreases in this phase, so, milk deprivation can provide knowledge to develop a preference for certain foods. Moreover, contradictory evidence exists of differential effect of sex of organism on sucralose intake, on one hand it has been reported that females tend to consume greater quantities of glucose or saccharine sweetened solutions in comparison to males (Valenstein, Cox y Kakolewski, 1967), and on the other hand, there is evidence that sex does not change sucralose intake (Loney, Torregrosa, Smith, Sclafani y Eckel, 2011).

Study on sweet flavor preference results relevant because it is the only definite example of innate preference to sense of taste. However, also of interest the study of interaction of this innate preference with the learned preference, such is case of sucralose sweet flavor preference as an effect from exposure. Nevertheless, also is important to observe influence that exposure to taste has on fluids intake in adult life. At the moment, it is considered that early exposure to sweet foods and beverages intake may be an important factor to obesity development in childhood (Institute of Medicine of the National Academies, 2004). Capaldi (1996) pointed out that repeated consumption of a specific food, increases preference for