RESUMEN

Existen muchos mecanismos implicados en la regulación de la ingesta, por ello, su estudio ha sido abordado desde distintas disciplinas. En psicología, los procedimientos experimentales suponen un gran aporte a la investigación de estos mecanismos, particularmente el análisis experimental del comportamiento ha permitido detectar numerosas variables que determinan nuestra preferencia alimentaria. Una de ellas es el sabor, el cual actúa como reforzador orosensorial, sin embargo, podemos aprender a preferir alimentos inicialmente no agradables al gusto y por ello se han empezado a considerar otras variables en el control ingestivo, como el valor calórico y/o contenido nutricional que produce un efecto reforzante gracias a las señales de saciedad generadas a nivel post-ingestivo. Nuestro estudio pretende ahondar en estos mecanismos de refuerzo post-ingestivos menos conocidos, poniendo a prueba mediante dos experimentos con ratas el efecto reforzante de dos sustancias respectivamente; Oleoiletanolamida (OEA) y Serotonina (SER), cuyos niveles en nuestro organismo se elevan tras la ingesta de alimentos calóricos y parecen estar implicadas en el proceso consumatorio; para profundizar en esta última sustancia (SER) emplearemos un inhibidor selectivo de su recaptación conocido como Fluoxetina (FLX). En ambos experimentos nuestro objetivo fue cambiar la preferencia de lugar inicial de los animales, los cuales poseen una preferencia natural por alguno de los lados, calculamos dicha preferencia inicial mediante una *Prueba de Preferencia de Dos Botellas* con soluciones de sacarina y posteriormente aplicamos un procedimiento de *Condicionamiento Preferente de Lugar* asociando el lado no preferido con el poder reforzante de la droga. El cambio de preferencia sólo ocurrió en el caso de la Oleoiletanolamida. Con este estudio buscamos comprender mejor los mecanismos que median el refuerzo de alimentos para que este conocimiento pueda usarse en la prevención de problemas como la obesidad o la ingesta compulsiva y promover hábitos nutricionales saludables.

ABSTRACT

There are many mechanisms involved in the regulation of food intake, therefore, this study has been approached from different disciplines. In psychology, experimental procedures have made a valuable contribution to the investigation of these mechanisms, particularly the experimental analysis of behavior has allowed the detection of numerous variables that determine our food preference. One of them is flavor, which acts as a sensorineural reinforcer, however, we can learn to prefer foods that are not initially pleasant to taste and for this reason other variables have been considered in the ingestive control, such as caloric value and/or nutritional content that produces a reinforcing effect thanks to the satiety signals generated at the post-ingestion level. Our study aims to develop into these lesser-known post-ingestive reinforcement mechanisms, testing the reinforcing effect of two substances, respectively, through two experiments with rats; Oleoylethanolamide (OEA) and Serotonin (SER), whose levels in our body rise after the intake of caloric foods and seem to be involved in the consuming process; to delve into this last substance (SER) we will use a selective inhibitor of its reuptake called Fluoxetine (FLX). In both experiments our objective was to change the preference of the initial place of the animals, which have a natural preference for one of the sides, we calculated this initial preference by means of a *Two-Bottle Preference Test* with saccharin solutions and later we applied a *Preferential Placement Conditioning* procedure associating the non-preferred side with the reinforcing power of the drug. The change in preference only occurred in the case of Oleoylethanolamide. We seek to further understand the mechanisms that mediate food reinforcement so that this knowledge could be used to prevent obesity problems or compulsive intake and promote healthy nutritional habits.

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TGF Psicología 2019-2020 (PS1048)

Beyond taste: postingestive conditioning

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INTRODUCTION

The consummatory behavior is mediated by variables that influence food choices, including flavor, which acts as a sensorineural enhancer. Other less well-known variables act in the reinforcement system at the post-management level, generating learning mechanisms and they are; nutritional and/or caloric value. A negative example of this learning is the conditioned aversion to taste, in the same way the positive consequences of eating help us to choose some foods over others, being more preferred foods with a higher caloric value regardless of the flavor. Therefore, although taste regulates the initial acceptance of a food, it seems that the post-ingestive factors regulate the intake by acting on the reward circuits.

Based on the previous literature, our hypothesis maintains that there are substances (Oleoylethanolamide and Serotonin) released after the action of nutrients at the post-ingestive level that act by sending signals of cerebral reinforcement and thus are able to promote our subsequent consumption and preference for food.

METHOD

Sample.
63 male rats strain Wistar. Average weight 524.32 gr.

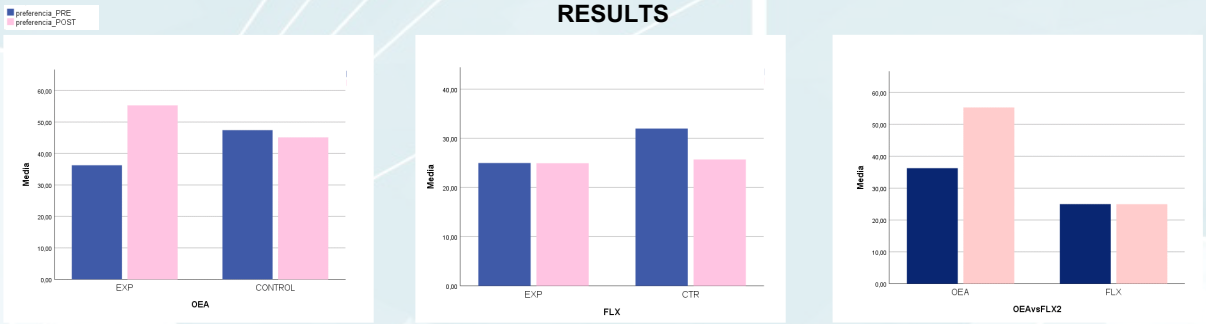
Materials.
63 individual box-rooms. Electronic precision scale.
92 50 ml Falcon tubes with anti-loss zippers.
24 gauge puncture needle with 1mm syringe.
Saccharin. Oleoylethanolamide and Fluoxetine.

Data Analysis.
Version 22.0 of the Statistical Package for Social Science (SPSS).
Comparision of means, ANOVA and Post-hoc.

Procedure. We tested two substances that we suspect may be related to post-ingestive enhancement; Oleoylethanolamide (OEA) and Serotonin (SER), this latest substance through its reuptake inhibitor called Fluoxetine (FLX). We carried out two experiments with the same procedure;

1. Baseline. *Two Bottle Preference Test* (3 days). To measure each animal's starting preference, two bottles of 1% saccharin solution are placed on opposite sides of the cage for 15 minutes. The lower consumption side will be the non-preferred one.
2. *Preferential Placement Conditioning* (6 days). We seek to increase the preference for the non-preferred side by associating that side with the reinforcing effects of the drug, OEA (experiment 1) or FLX (experiment 2). On even days drug is administered to the experimental group and vehicle to the control group and the solution is placed on the non-preferred side 30 minutes, while on odd days there is no administration of the drug or vehicle and the solution is placed on the preferred side for another 30 minutes.
3. Probe. *Two Bottle Preference Test* (3 days). By repeating this test we check if there is a significant change in the initial preference of the experimental group with respect to those of the control group.

RESULTS



For Oleoylethanolamide we find no significant differences, the experimental group presents M= 55.29, SE= 19.16 and the control group, M=45.10, SE= 17.44. (t (1.148) = -1.94, p >.05), in this case *p*= 0.269, that is > .05. For Fluoxetine there are no differences either, the experimental group presents M= 24.94, SE= 9.70 and the control group, M=25.70, SE= 12.46 (t (-.232), p >.05), in this case *p* = 0.817, that is > .05.

Significant differences are found between the group OEA M: 36.25, D.T. 12.50 and the group FLX, M: 24.98, D.T. 8.76 in pre-treatment measurement (t (2.82), p =.008), *p*<.05. Also for the group OEA, M: 55.29, D.T. 19.16 and the group FLX, M: 24 D.T. 9.73 in post-treatment measurement (t (5.90), p <.000), *p*<.05.

DISCUSSION

The Oleoylethanolamide results are inconclusive. The preference for the non-preferred side increases in the experimental group without actually associating this increase with a possible reinforcing power because the results are not statistically significant. In any case, the change in preference obtained is consistent with previous knowledge about the Oleoylethanolamide. It is known that this substance is released after ingestion and its levels decrease with food deprivation, which seems to indicate that it encourages consumption at low levels of nutrients. It also appears to act as a signal of satiety and has been linked to modulation of dopaminergic function.

The results of Fluoxetine are also inconclusive, and the reinforcing power of this Serotonin reuptake inhibitor substance has not been demonstrated. This can be related to its satiating power, because although the satiating effect of food is reinforcing, at the same time it is recognized that "excessive" satiety can be aversive.

For future research we could reduce the administered dose to avoid "excessive" satiety, we could even administer different doses to check if the effects vary. It would also be interesting to include female rats in the study.

It is important to consider the reinforcing power of certain substances involved in the feeding process to prevent obesity, compulsive intake, and promote healthy nutritional habits.

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BIBLIOGRAFÍA

- Ackroff, K., Yiin, Y., & Sclafani, A. (2010). Post-oral infusion sites that support glucose conditioned flavor preferences in rats. *Physiology & Behavior, 99*(3), 402-411. http://doi.org/10.1016/j.physbeh.2009.12.012
- Araujo, I., Oliveira-Maia, A., Sotnikova, T., Gainetdinov, R., Caron, M., Nicolelis, M., & Simon, S. (2008). Food Reward in the Absence of Taste Receptor Signaling. *Neuron, 57*(2), 930-941. http://doi.org/10.1016/j.neuron.2008.04.003
- Ackroff, K., & Sclafani, A. (2004). La relación entre la recompensa alimentaria y la saciedad revisitada. *Psysiology & Behavior, 82*(1), 89-95. https://doi.org/10.1016/j.physbeh.2004.04.045
- Benoit, S. C. & Tracy, A. L. (2008). Behavioral controls of food intake. *Peptides, 29*(1),139-147. https://doi.org/10.1016/j.peptides.2007.10.019
- Bezençon, C., le Coutre, J., & Damak, S. (2007). Taste-signaling proteins are coexpressed in solitary intestinal epithelial cells. *Chemical Senses, 32*(1), 41-49. https://doi.org/10.1093/chemse/bjl034
- Blusck, D., Ackroff, K., Sclafani, A. (1994). Nutrient-conditioned flavor preference and acceptance in rats: Effects of deprivation state and nonreinforcement. *Physiology & Behavior, 56*(4), 701-707, https://doi.org/10.1016/0031-9384(94)90230-5
- Cummings, D. E. & Overduin, J. (2007). Gastrointestinal regulation of food intake. *The Journal of clinical investigation, 117*(1), 13-23, http://doi.org/10.1172/JCI30227
- Dwyer, D.M., Gasalla, P., Bura, S. & López, M. (2017). Flavors paired with internal pain or with nausea elicit divergent types of hedonic responses. *Behavioral Neuroscience, 131* (3), 235–248. https://doi.org/10.1037/bne0000197
- Gómez-Boronat, M., Velasco, C., Isorna, E., De Pedro, N., Delgado, M. J., & Soengas, J. L. (2016). The satiety factor oleoylethanolamide impacts hepatic lipid and glucose metabolism in goldfish. *Journal of comparative physiology. B, Biochemical, systemic, and environmental physiology, 186*(8), 1009–1021. https://doi.org/10.1007/s00360-016-1009-x
- Ishii, Y., J.E Blundell, J. E., Halford, J. & Rogers, R. J. (2003). Palatability, food intake and the behavioural satiety sequence in male rats. Physiology & Behavior, 80(1), 37-47. https://doi.org/10.1016/S0031-9384(03)00207-5
- Menningen, J. A., Harris, A., Chang, J. P., Moon, T. W. & Trudeau, V. L. (2009). Fluoxetine affects weight gain and expression of feeding peptides in the female goldfish brain. *Regulatory Peptides, 155*(3), 99-104. https://doi.org/10.1016/j.regpep.2009.01.001
- Murillo, E., Palomero, M., Millán, D., Arias, O. & Drucker., R. (2011). Administration of URB597, Oleoylethanolamide or Palmitoylethanolamide Increases Waking and Dopamine in Rats. *PLoS ONE, 6*(7), 20766. https://doi.org/10.1371/journal.pone.0020766
- Pérez, C., Lucas, F., & Sclafani, A. (1998). Increased flavor acceptance and preference conditioned by the postingestive actions of glucose. *Physiology & Behavior, 64*(4), 483-492. http://doi.org/10.1016/S0031-9384(98)00104-8
- Rodríguez de Fonseca, F., Navarro, M., Gómez, R. et al. (2001). Un mediador lipídico anoréxico regulado por la alimentación. *Nature 414*(1), 20-212. https://doi.org/10.1038/35102582
- Santacoloma, A., Quiroga, L. (2009). Perspectivas de estudio de la conducta alimentaria. *Revista Iberoamericana de Psicología: Ciencia y Tecnología, 2*(2), 7-15. https://doi.org/10.33881/2027-1786.rip.2201
- Schier, L., & Spector, A. (2016). Post-oral sugar detection rapidly and chemospecifically modulates taste-guided behavior. *American Journal Of Physiology-Regulatory, Integrative And Comparative Physiology, 311*(4), R742-R755. https://doi.org/10.1152/ajpregu.00155.2016
- Sclafani, A. (2001). Post-ingestive positive controls of ingestive behavior. *Appetite, 36*(1), 79-83. https://doi.org/10.1006/appe.2000.0370
- Tellez, L. A., Medina, S., Han, H., et al. (2013). A Gut Lipid Messenger Links Excess Dietary Fat to Dopamine Deficiency. *Science, 341*(6147), 800-802, https://doi.org/10.1126/science.1239275
- Ward, A. S., Comer, S. D., Haney, M., Fischman, M. W. & Foltin, R. W. (1999). Fluoxetine-Maintained Obese Humans: Effect on Food Intake and Body Weight. *Psysiology & Behavior, 66*(5), 815-821, https://doi.org/10.1016/S0031-9384(99)00020-7
- Wurtman J. J. (1984). The involvement of brain serotonin in excessive carbohydrate snacking by obese carbohydrate cravers. *Journal of the American Dietetic Association*, *84*(9), 1004–1007.
- Yeomans, M. R., Gray, R. W., Mitchell, C. J. & True, S. (1997). Independent effects of palatability and within-meal pauses on intake and appetite ratings in human volunteers. *Appetite, 29*(1), 61-76. https://doi.org/10.1006/appe.1997.0092
- Zahorik, D.M. & Bean, C.A. (1975). Resistance of “recovery” flavors to later association with illness. *Bulletin of the Psychonomic Society, 6* (3), 309–312. https://doi.org/10.3758/BF03336672