Effects of flavor supplements in sheep rations on expression of: SGLT1, Sweet Taste Receptors and functional genes in the Proximal Small Intestine

Areen Dallasheh[a], Felista Mwangi[a], Enav Bar-Shira[a], Yosi Wein[a], Zehava Uni[a], Eran Elinav[b], Mally Dori-Bachash[b] and Sameer. J. Mabjeesh[a]
[a]The Robert H. Smith Faculty of Agriculture, Food and Environment The Hebrew University, Rehovot, Israel
[b]Immunology Department, Weizmann Institute of Science, Rehovot, Israel

THE HEBREW UNIVERSITY OF JERUSALEM

Introduction

Feed preference and consumption by animals is influenced by various factors including flavor and taste. Flavors modulate the sensory characteristics of feeds to increase voluntary intake, aid in selection for nutritious feed and rejection of feed with low nutrient content or those with toxins in ruminants. Another factor affecting nutrient intake, is the stimulation of the taste receptors such as the sweet taste receptors. The presence of sugars such as glucose and galactose in the intestinal tract increases the expression of the sweet taste receptors, T1R2-T1R3, on the Enteroendocrine cells, which increases the expression of the glucose transporter, SGLT1, in Enterocyte cells. These stimuli increase functional gene expression and hormones that influence intestinal uptake, metabolism, and homeostasis of glucose.
This study aimed to characterize the effect of artificial flavor compounds in diet of ruminants on feed efficiency and feed intake. We also studied the effect of flavors on the expression of: sweet taste receptor (T1R2-T1R3), glucose transporter (SGLT1) and other functional genes in the small intestines.

Methods

Eight; five months old sheep were randomly assigned to 4 treatments. The treatments were: Sucram, Capsicum, Mix (Sucram and Capsicum at 1:1 ratio) and no flavor as a control. Sheep were offered total mixed ration (TMR), whole corn grain and pellets in 50:25:25 ratio, respectively formulated to ensure 15.7% CP and 2.68 ME/kg on DM basis. After 14 days' exposure to the flavors, total collection of urine, feces and refusals was carried out for chemical analysis.

Intestinal biopsies were taken from the proximal jejunum by full thickness biopsy technique and later, relative gene expression of: T1R2, T1R3, SGLT1, GLP-1, GLP-2, CCK, AP-N, and ATPase determined by RT-PCR. To determine the gut microbiota composition, 16S rRNA sequence analysis was performed on intestinal digesta samples from each sheep.

Results

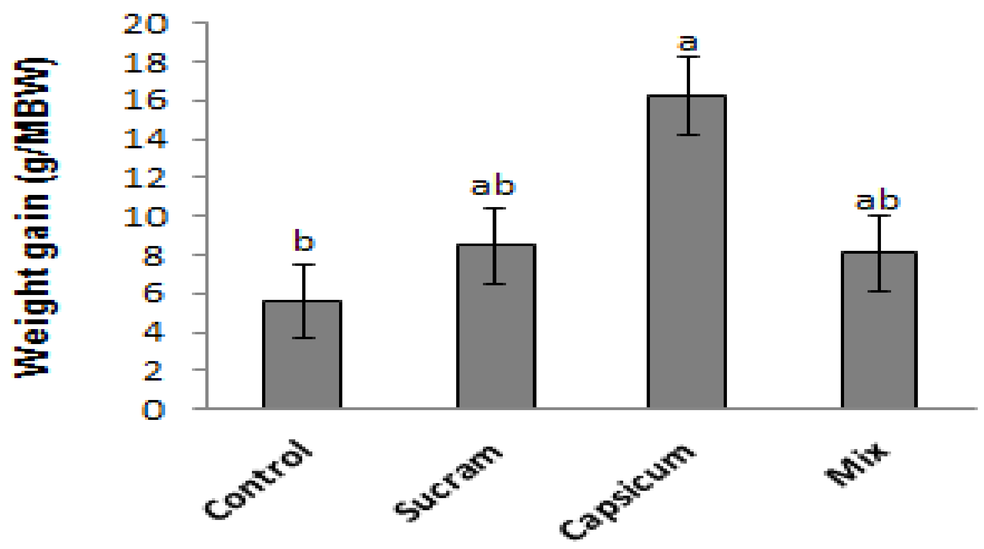

Figure 1: Effect of artificial flavors on average daily weight gain expressed in grams per metabolic body weight (g/MBW) in sheep. Results are least square means ± SE. levels significantly ($P < .05$)

Sheep fed on Capsicum flavored diet gained more weight (16.2 g/MBW) compared to other treatments (Fig. 1).

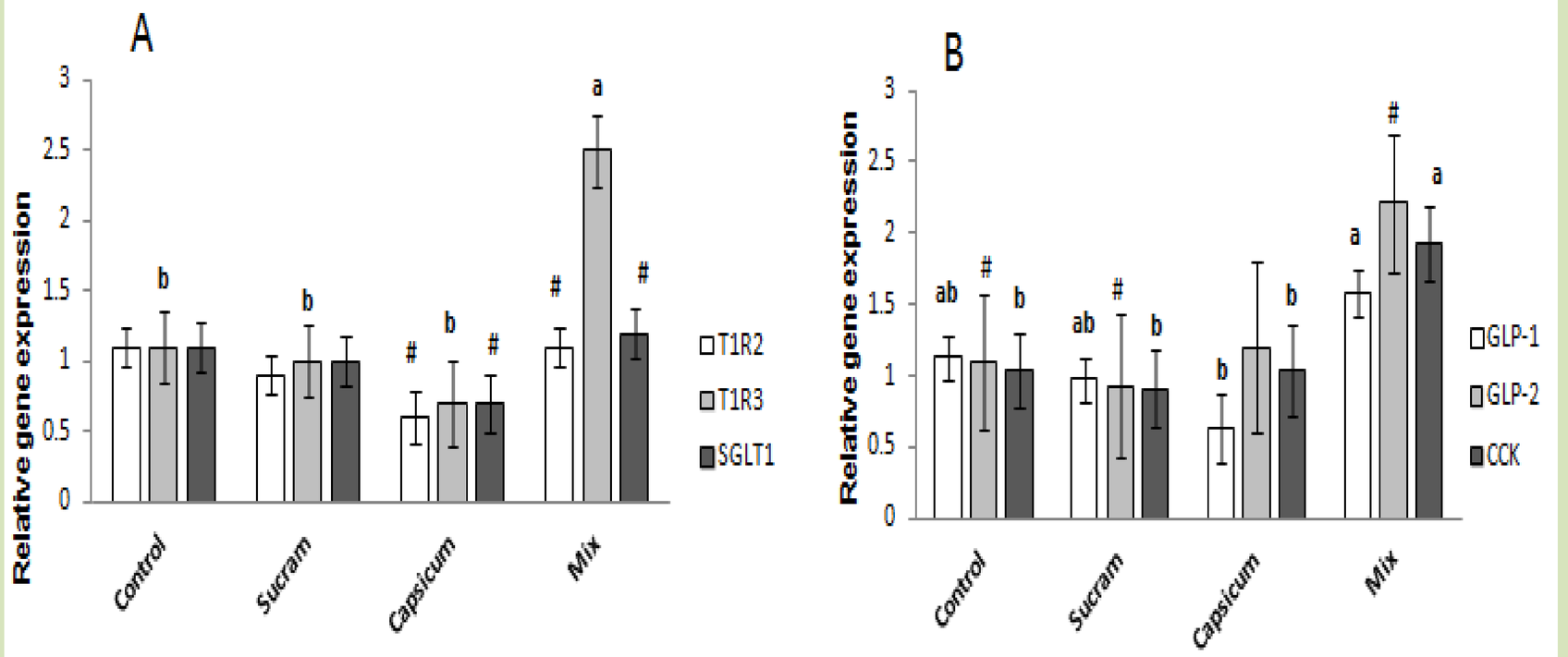

Figure 2: **(A) Effects of artificial flavors on relative expression of Sweet Taste Receptors T1R2, T1R3, and SGLT1 in proximal intestine. (B) Effects of artificial flavors on relative expression of GLP-1, GLP-2 , and CCK hormones in sheep proximal intestine . Results are least square means ± SE. levels significantly ($P < .05$).**
T1R3 ,T1R2 and SGLT1 relative genes expression was greater with Mix. GLP-1, CCK , GLP-2 relative expression was greatest with Mix compared to other treatments.

Conclusion

- **Flavors can be used to motivate feed acceptance in ruminants and thereby improve feed intake, and efficiency in sheep.**
- **Supplementing sheep with Capsicum together with Sucram had a synergistic effect that increased T1R2, T1R3 and SGLT1 gene expression. This may increase glucose absorption and metabolism and consequently growth efficiency.**
- **Strategies that include artificial flavor supplements can be used to increase feed intake especially those with low sensory attributes.**
- **Flavors supplements did not affect the microbial profile at the proximal jejunum.**