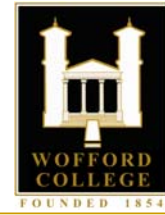


# LINOLEIC ACID ALTERS LICKING RESPONSES TO SWEET, SOUR, AND SALT TASTANTS IN RATS.

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## Introduction

It is known that rats can discriminate and prefer dietary fats, particularly corn oil, on the basis of orosensory information. One possible explanation of the fat preference involves a role for the gustatory system in the detection of fat in the oral cavity. If we assume that dietary fat is detected by the gustatory system, then free fatty acids are a likely candidate to be the "tastable" chemical component.

Corn oil, the prototypical dietary fat in rodent research, has three major free fatty acid components: linoleic acid (52%); oleic acid (31%); and palmitic acid (13%). In isolated rat taste receptor cells, linoleic acid inhibited delayed-rectifying K<sup>+</sup> channels. This research suggests a transduction mechanism for the detection of linoleic acid by the gustatory system. Furthermore, the net effect of inhibiting the delayed-rectifying channels would suggest prolonged depolarization in response to taste stimuli. Therefore, a given concentration of tastant would theoretically produce a larger gustatory neural signal when in the presence of linoleic acid.

We hypothesized that the presence of linoleic acid would increase the neural signal for a given concentration of tastant producing a greater perceived intensity than when that tastant was presented alone. The licking responses of rats to sweet, salty, and sour tastants with and without 88µM linoleic acid was measured.

## Methods

### CHEMICAL STIMULI

- Sucrose:** 16, 31, 62, 125, 250 mM
  - NaCl:** 31, 62, 125, 250, 500, 1000 mM
  - Citric Acid:** 2, 4, 8, 15, 30, 60 mM
  - Bitter:** 1, 2, 4, 8, 15, 30 mM \* EXP A ONLY
  - Linoleic Acid:** 88 micromolar (28 µl / 1 L solution)
- All solutions were mixed in 5 mM ethanol (ETOH)

### BEHAVIORAL TESTING

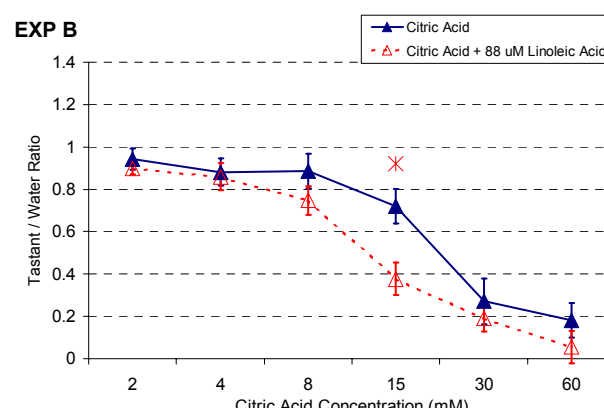
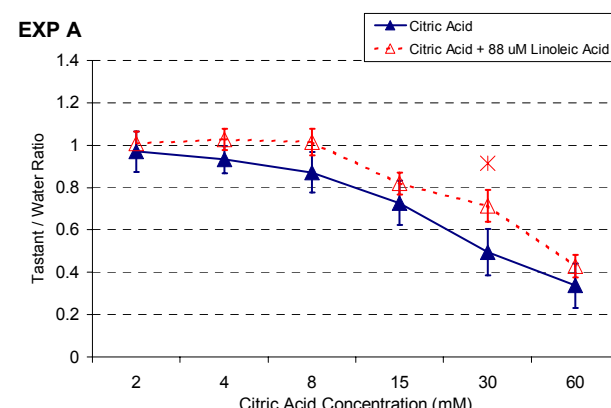
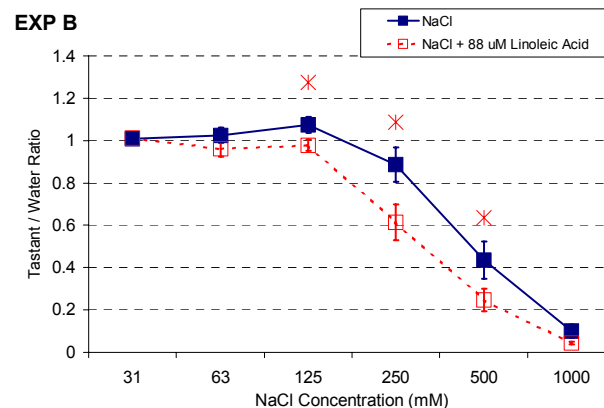
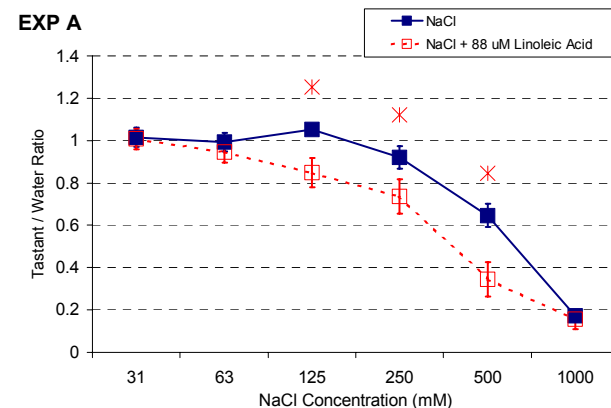
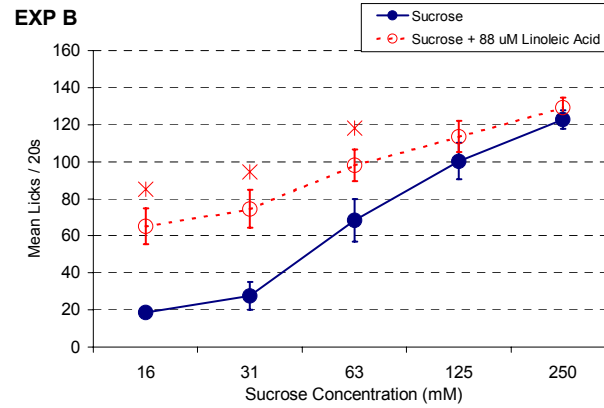
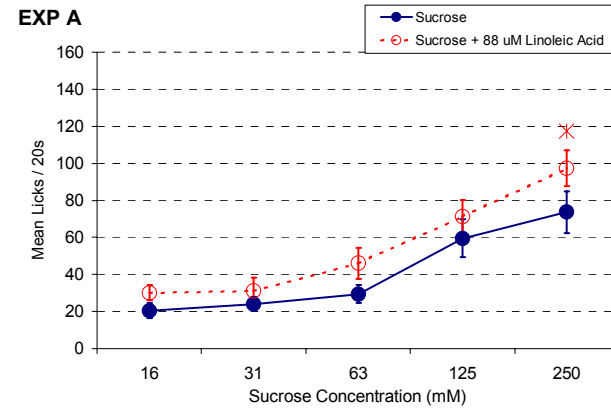
All testing was conducted in a MS-160 Davis Rig. Each daily test session included 2 ascending order presentations of the test stimuli. Test stimuli were presented in 20s trials with 40s inter-trial intervals. Rats were on a 23.5 hr water restriction schedule, during training and the NaCl, citric acid, & QHCl testing conditions. During testing under the water restriction conditions, a water stimulus (5 mM ETOH) was presented every 3<sup>rd</sup> trial.

### EXP A:

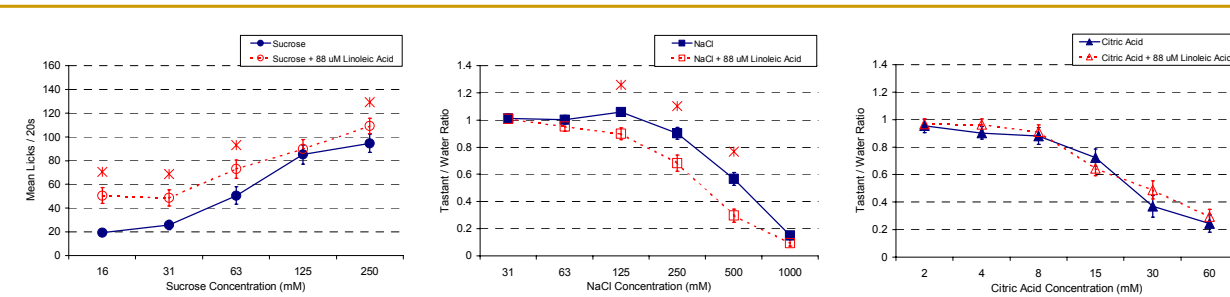
- Subjects: 10 naive male Sprague-Dawley rats (CRL:CD(SD)IGS) greater than 90 days old at the start of the experiment
- Training: 2 days of 23.5 hr water access – Week 1: 30 min water access in the Davis Rig (15 90s trials with 10s inter-trial interval); Week 2: 500 mM sucrose (10 20s trials with 40s inter-trial interval)
- Testing Paradigm: 4 weeks each consisting of 4 days of testing (Tuesday-Friday). One tastant was tested per week (week 1: sucrose; week 2: NaCl; week 3: citric acid; week 4: QHCl). Within each week Days 1&2 = tastant alone & Days 3&4 = tastant with 88µM linoleic acid.

### EXP B:

- Subjects: 12 naive male Sprague-Dawley rats (CRL:CD(SD)IGS) greater than 90 days old at the start of the experiment
- Training: Days 1&2: 30 min water access on home cage; Day 3: 30 min water access in the Davis Rig (15 90 trials with 10s inter-trial interval); Day 4: 500 mM sucrose (10 20s trials with 40s inter-trial interval)
- Testing Paradigm: Day 5: NaCl + 88µM linoleic acid; Day 6: NaCl alone; Day 7: citric acid + 88µM linoleic acid; Day 8: citric acid alone; Day 9: sucrose + 88µM linoleic acid; Day 10: sucrose alone



Stars represent significant differences (p < 0.05).



Combined data from EXP A & B for each tastant with and without 88µM linoleic acid. Stars represent significant differences (p < 0.05).

## Results

- **Linoleic acid increased the licking response to sucrose** at almost all concentrations. The addition of linoleic acid never decreased the licking response to sucrose.
- **Linoleic acid decreased the licking response to NaCl** as the concentration of salt increased toward aversive amounts. The addition of linoleic acid never produced an increase in the licking response to NaCl.
- **Linoleic acid decreased the licking response to citric acid.** In EXPA, linoleic acid appeared to increase the licking response to citric acid; HOWEVER, in EXPB linoleic acid decreased the licking response to citric acid. Differences in training and testing paradigms may exert considerable influences on the behavioral gustatory responses of rats. Based on the response rate data (Table 1), the data collected in EXPB most likely reflects the true effect of linoleic acid on citric acid intake.

Table 1. Response rate data for each tastant in experiment A (n=10) and experiment B (n=12)

	Sucrose		Sucrose + LA		NaCl		NaCl + LA		Citric Acid		Citric Acid + LA	
	Exp	Rate	Exp	Rate	Exp	Rate	Exp	Rate	Exp	Rate	Exp	Rate
EXP A	82	27%	88	29%	217	90%	141	59%	74	31%	161	67%
EXP B	95	79%	80	67%	103	72%	104	72%	105	73%	103	72%

## Conclusions

Linoleic acid acts to increase the intensity of sweet, salty, and sour tastants such that the natural preference or avoidance of each tastant is enhanced.

Future areas of interest include:

- the effect of increasing the concentration of linoleic acid on the modulation of tastant intake
- the ability of other free fatty acids, such as palmitic and oleic acid, to alter tastant intake
- the applicability of this rodent model to human detection and perception of free fatty acids

## Acknowledgements

This research was supported by funding from the office of Dean of the College, Wofford College.

Our latest research on the taste of fat can be found at:

<http://FatTaste.ontheweb.nu>

