Final Progress Report for Research Projects Funded by Health Research Grants

Instructions: Please complete all of the items as instructed. Do not delete instructions. Do not leave any items blank; responses must be provided for all items. If your response to an item is "None", please specify "None" as your response. "Not applicable" is not an acceptable response for any of the items. There is no limit to the length of your response to any question. Responses should be single-spaced, no smaller than 12-point type. The report **must be completed using MS Word**. Submitted reports must be Word documents; they should not be converted to pdf format. Questions? Contact Health Research Program staff at 717-783-2548.

1. **Grantee Institution:** Monell Chemical Senses Center

2. **Reporting Period (start and end date of grant award period):** 01/01/12-12/31/2012

3. **Grant Contact Person (First Name, M.I., Last Name, Degrees):**Gary K. Beauchamp, PhD

4. **Grant Contact Person's Telephone Number:** 267-519-4700

5. **Grant SAP Number:** 4100057669

6. **Project Number and Title of Research Project:** 2 - Salivary Calcium and Taste

7. **Start and End Date of Research Project:** 01/01/12-12/31/2012

8. **Name of Principal Investigator for the Research Project:** Anna Voznesenskaya, PhD

9. **Research Project Expenses**.

   9(A) Please provide the total amount of health research grant funds spent on this project for the entire duration of the grant, including indirect costs and any interest earned that was spent:

   $110,715

   9(B) Provide the last names (include first initial if multiple individuals with the same last name are listed) of **all** persons who worked on this research project and were supported with health research funds. Include position titles (Principal Investigator, Graduate Assistant, Post-doctoral Fellow, etc.), percent of effort on project and total health research funds expended for the position. For multiple year projects, if percent of effort varied from year to year, report in the % of Effort column the effort by year 1, 2, 3, etc. of the project (x% Yr 1; z% Yr 2-3).

Last Name	Position Title	% of Effort on Project	Cost

Voznesenskaya	Postdoctoral Fellow	79%	$33,602.59

9(C) Provide the names of **all** persons who worked on this research project, but who *were not* supported with health research funds. Include position titles (Research Assistant, Administrative Assistant, etc.) and percent of effort on project. For multiple year projects, if percent of effort varied from year to year, report in the % of Effort column the effort by year 1, 2, 3, etc. of the project (x% Yr 1; z% Yr 2-3).

Last Name	Position Title	% of Effort on Project
None		

9(D) Provide a list of **all** scientific equipment purchased as part of this research grant, a short description of the value (benefit) derived by the institution from this equipment, and the cost of the equipment.

Type of Scientific Equipment	Value Derived	Cost
None		

10. Co-funding of Research Project during Health Research Grant Award Period. Did this research project receive funding from any other source during the project period when it was supported by the health research grant?

Yes_____ No__X_____

If yes, please indicate the source and amount of other funds:

11. Leveraging of Additional Funds

11(A) As a result of the health research funds provided for this research project, were you able to apply for and/or obtain funding from other sources to continue or expand the research?

Yes_X___ No_____

If yes, please list the applications submitted (column A), the funding agency (National Institutes of Health—NIH, or other source in column B), the month and year when the application was submitted (column C), and the amount of funds requested (column D). If you have received a notice that the grant will be funded, please indicate the amount of funds to be awarded (column E). If the grant was not funded, insert "not funded" in column E.

Do not include funding from your own institution or from CURE (tobacco settlement funds). Do not include grants submitted prior to the start date of the grant as shown in Question 2. If you list grants submitted within 1-6 months of the start date of this grant, add a statement

below the table indicating how the data/results from this project were used to secure that grant.

A. Title of research project on grant application	B. Funding agency (check those that apply)	C. Month and Year Submitted	D. Amount of funds requested:	E. Amount of funds to be awarded:
Does calcium help us avoid salt and sugar?	☐NIH ☐ Other federal (specify:_____ _____) ☒ Nonfederal source (specify: _Dairy Research Institute® (DRI))	February 2013	$100,000	$

11(B) Are you planning to apply for additional funding in the future to continue or expand the research?

Yes_X__ No_____

If yes, please describe your plans:

The results of this project will be used to apply for the R03 NIH grant.

12. Future of Research Project. What are the future plans for this research project?

We have tested all the hypotheses; thus, this research project is completed. However, the results of this study led to formation of a new hypothesis that will be addressed in further research. Our results demonstrate that dietary calcium intake is related to perception of several taste compounds. We plan to conduct further studies to investigate possible mechanisms underlying this connection and assess whether changes in taste perception contribute to beneficial effects of calcium in maintaining healthy diet, and prevention and management of metabolic diseases.

13. New Investigator Training and Development. Did students participate in project supported internships or graduate or post-graduate training for at least one semester or one summer?

Yes_____ No__X__

If yes, how many students? Please specify in the tables below:

	Undergraduate	Masters	Pre-doc	Post-doc
Male				
Female				
Unknown				
Total				

	Undergraduate	Masters	Pre-doc	Post-doc
Hispanic				
Non-Hispanic				
Unknown				
Total				

	Undergraduate	Masters	Pre-doc	Post-doc
White				
Black				
Asian				
Other				
Unknown				
Total				

14. Recruitment of Out-of–State Researchers. Did you bring researchers into Pennsylvania to carry out this research project?

Yes_____ No_X____

If yes, please list the name and degree of each researcher and his/her previous affiliation:

15. Impact on Research Capacity and Quality. Did the health research project enhance the quality and/or capacity of research at your institution?

Yes_____ No__X___

If yes, describe how improvements in infrastructure, the addition of new investigators, and other resources have led to more and better research.

16. Collaboration, business and community involvement.

16(A) Did the health research funds lead to collaboration with research partners outside of your institution (e.g., entire university, entire hospital system)?

Yes_____ No__X____

If yes, please describe the collaborations:

16(B) Did the research project result in commercial development of any research products?

Yes_____ No___X__

If yes, please describe commercial development activities that resulted from the research project:

16(C) Did the research lead to new involvement with the community?

Yes_____ No___X___

If yes, please describe involvement with community groups that resulted from the research project:

17. Progress in Achieving Research Goals, Objectives and Aims.

List the project goals, objectives and specific aims (as contained in the grant agreement). Summarize the progress made in achieving these goals, objectives and aims for the period that the project was funded (i.e., from project start date through end date). Indicate whether or not each goal/objective/aim was achieved; if something was not achieved, note the reasons why. Describe the methods used. If changes were made to the research goals/objectives/aims, methods, design or timeline since the original grant application was submitted, please describe the changes. Provide detailed results of the project. Include evidence of the data that was generated and analyzed, and provide tables, graphs, and figures of the data. List published abstracts, poster presentations and scientific meeting presentations at the end of the summary of progress; peer-reviewed publications should be listed under item 20.

This response should be a DETAILED report of the methods and findings. It is not sufficient to state that the work was completed. Insufficient information may result in an unfavorable performance review, which may jeopardize future funding. If research findings are pending publication you must still include enough detail for the expert peer reviewers to evaluate the progress during the course of the project.

Health research grants funded under the Tobacco Settlement Act will be evaluated via a performance review by an expert panel of researchers and clinicians who will assess project work using this Final Progress Report, all project Annual Reports and the project's strategic plan. After the final performance review of each project is complete, approximately 12-16 months after the end of the grant, this Final Progress Report, as well as the Final Performance Review Report containing the comments of the expert review panel, and the grantee's written response to the Final Performance Review Report, will be posted on the CURE Web site.

There is no limit to the length of your response. Responses must be single-spaced below, no smaller than 12-point type. If you cut and paste text from a publication, be sure symbols print properly, e.g., the Greek symbol for alpha (α) and beta (ß) should not

print as boxes (☐) and include the appropriate citation(s). DO NOT DELETE THESE INSTRUCTIONS.

Specific Aims: We hypothesize that salivary calcium affects taste perception, particularly the perception of calcium. We also hypothesize that salivary calcium content depends on physiological status (including calcium levels in the body) thus enabling the regulation of dietary choices through salivary content. The aims of this project are to study in healthy human subjects: 1) the influence of salivary calcium content on taste detection thresholds, taste sensitivity, and liking of calcium and several other compounds, and 2) the influence of dietary calcium intake on salivary calcium content and taste perception.

We have completed all the research activities planned for the reporting period (January 1st 2012 to December 31st 2012). We have addressed both specific aims, and reached our research goals.
Our results indicate that there is no direct relationship between salivary calcium concentrations and taste perception of calcium and sweet compounds. Dietary calcium intake is associated with taste perception of $CaCl_2$, sour and sweet compounds. However, this relationship is unlikely to be mediated through changes in salivary calcium concentrations, and may be modulated by ethnic background.

Summary of Research Completed

We have recruited 47 subjects, 40 of which have completed the study (20 men and 20 women).
All 40 participants have completed study sessions #1 to #7 according to the study research plan.
Detailed breakdown of the sessions and data collected during each session are provided in Table 1. Methods used to collect this data are described in detail below.

There were changes in the study design involving sessions #5 - #7. The changes in the study design are in line with the initial research plan. During sessions #5 - #7 we planned to measure several taste parameters after altering the salivary calcium concentrations by giving calcium supplements to our subjects. These sessions were planned to take place only if changes in salivary calcium concentrations after supplement treatment were detected. However, the results have revealed high variability in basal salivary calcium content between individuals and a very small increase in salivary calcium in response to supplementation with 1000 mg of calcium (Fig.1). Therefore, we changed the design of the study so that within–subject comparisons could be made: During sessions #5-#7 each subject received vehicle or 1000mg or 2000mg calcium supplement. Samples of unstimulated and stimulated saliva were collected four times: prior to giving calcium supplements to the study participants and 1h, 2h and 3h after. The order of sessions in which the different types of treatment were given was randomized between the subjects. Each subject received all three types of treatment within the study.
The changes in the study design led to an increase in effort of principal investigator: extra time was required to analyze a larger amount of salivary samples, for data entry and to carry longer testing procedures.

Detection thresholds

Detection thresholds for sucrose and $CaCl_2$ were determined using a forced-choice staircase method. A series of $CaCl_2$ solutions ranging from $1x10^{-7}$ to 10 mM, and a series of sucrose solutions ranging from $1x10^{-6}$ to 1 M were used in these procedures. The $CaCl_2$ dilution series comprised of 33 quarter-log dilution steps; the sucrose dilution series consisted of 25 quarter-log dilution steps. Solutions were prepared with deionized (DI) water. Solutions and DI water (serving as a blank) were presented to study participants in plastic medicine cups each containing 10 mL of the sample. Each subject was presented with a series of trials with a blank and a solution. During each trial, participants were asked to identify which of the two samples had a taste to it. Participants were not informed about the nature of the substance or taste quality they were trying to detect. One incorrect response led to an increase in solution concentration on the next trial; after two consecutive correct responses the concentration used on the next trial was decreased. The point at which the solution series presenting order changed its direction (from ascending to descending or vice versa) was defined as a reversal. The testing procedure was completed after 5 reversals. Detection threshold was calculated as an average of dilution steps of the last four reversals.

Intensity and liking measures

We chose to measure the liking and intensity ratings of 5 taste compounds of different taste modalities: sweet (sucrose), sour (citric acid), bitter (quinine hydrochloride (QHCl)), salty (sodium chloride (NaCl)) and calcium ($CaCl_2$). Each of the 5 taste compounds was presented in "low", "medium" and "high" concentrations. Those were: for sucrose 10 mM, 316 mM and 1M; for citric acid 0.25 mM, 2 mM and 25 mM; for NaCl 10 mM, 150 mM and 500 mM; for QHCl 0.001mM, 0.05 mM and 0.25 mM; for $CaCl_2$ 10 mM, 25 mM and 70 mM. Subjects were asked to rate their liking and perceived intensity of the solutions on 9-point and 12-point analogue scales respectively. Each subject was presented with a set of samples containing DI water and all taste compounds at low, medium and high concentrations. Low concentrations were presented first, medium second and high last. The solution order was randomized within each concentration. That is, each participant was presented with (1) a set of low concentrations of 5 taste solutions plus DI water three times, (2) a set of medium concentrations of 5 taste solutions plus DI water three times, (3) a set of high concentrations of 5 taste solutions plus DI water three times. Solutions were provided in 10 mL samples in plastic medicine cups.

Supplement treatment

For session #2 subjects were randomly assigned to either a placebo or calcium supplement treatment procedure. Two capsules filled with microcellulose served as a placebo treatment; the calcium supplement consisted of two tablets each containing 500 mg of calcium (CVS pharmacy®, "Oyster Shell Calcium"). Participants were instructed to drink a 200-mL cup of tap water with the supplements. Stimulated and unstimulated saliva samples were collected immediately before and 1, 2, 3 and 4 h after consuming the supplements. Sessions #5 to #7 were similar to session #2, however each subject received 1000 mg, 2000 mg and placebo on separate sessions and the order in which these sessions occurred was randomized between the

subjects. Three capsules filled with microcellulose served as a placebo treatment during these sessions.

Daily dietary calcium intake was assessed using a validated food frequency questionnaire (Sebring et al., 2007).

Saliva collection procedure

Our methods for saliva collection followed those described by Navazesh (Ann NY Acad Sci 1993;694:72-7). For unstimulated saliva collection, each participant was asked to rinse his or her mouth with DI water and relax for five minutes. Then the subject was asked to swallow to void the mouth of saliva, stay relaxed, minimize all orofacial movements and keep the mouth closed. The experimenter prompted subjects to spit into the 15-mL plastic tube containing ~3 mL of mineral oil every minute for 5 min.

Unstimulated saliva collection was followed by the collection of stimulated saliva. To stimulate saliva production, subjects were asked to chew a 5 x 5-cm piece of paraffin film, making 70 chewing movements per minute following the sound of a metronome. Saliva collected during first two minutes of chewing was discarded. At the end of each minute of the following three minutes, the subjects were prompted to expectorate into the tube.

Salivary calcium and pH measurement

Saliva samples were centrifuged for 10 min at 3000 rpm, weighed, and calcium and pH were measured in triplicate using a Siemens RAPIDLab 348 gas and electrolyte analyzer.

Total calcium concentrations were measured in using a colorimetric assay based on the formation of a chromogenic complex between calcium ions and 0-cresophthalein (BioVision, Mountain View, CA).

Data analyses and findings

Data on detection thresholds and psychophysical ratings were not normally distributed. Therefore we used non-parametric statistics in analyses involving these measurements. Relationships among salivary parameters (pH, flow rate and calcium concentrations of stimulated and unstimulated saliva), dietary calcium intake and taste perception were assessed using Spearman rank-order correlation analyses and Mann-Whitney U-statistic where applicable. We assessed within-group correlations among calcium intake, salivary and taste parameters for Caucasians and African-Americans because of the known disparities in calcium metabolism and taste perception between these groups. Out of 40 participants that completed the study 12 identified themselves as African-American and 18 as Caucasian. Repeated measures ANOVA with factors of DOSE (0 mg, 1000 mg and 2000 mg) and TIME (1h, 2h and 3h after the treatment) was used to evaluate the effects of calcium supplements on salivary calcium concentrations. A χ^2 test was used to analyze between-group differences in taste quality ratings.

Influence of dietary calcium intake on salivary parameters

There was no relationship between dietary calcium intake and salivary calcium concentrations.

Treatment with 1000 or 2000 mg of calcium also did not provoke any changes in salivary calcium concentrations (Dose x Time: $F_{4, 148} = 1.2$, $p = 0.30$ and $F_{4, 136} = 0.4$, $p = 0.83$ for unstimulated and stimulated saliva respectively).

Influence of dietary calcium intake on taste perception

There was no association between dietary calcium intake and calcium detection threshold. However, subjects with adequate calcium intake (>1000 mg/day) perceived 70 mM of $CaCl_2$ as predominantly salty more frequently (i.e., rated 70 mM $CaCl_2$ as sour ≥ 2 times out of 3 presentations) than the subjects with low calcium intake ($\chi^2 = 8.32$, df = 1, $p = 0.004$;). Differences in dietary calcium intake explain about 17.6 % of observed variance in intensity ratings of 10 mM $CaCl_2$ (Spearman's rho (r_s) = -0.42, p=0.005) in the whole sample (Fig.2), and 50% of variance in the group of African-American subjects ($r_s = -0.71$, p=0.009). Dietary calcium intake was strongly correlated with sucrose detection threshold in African-Americans (but not in Caucasians) ($r_s = -0.93$, $p<0.001$, Fig.3) and related to the frequency of sour-bitter confusion in this ethnic group: The lower was the daily calcium intake in African-Americans, the more 25 mM citric acid was rated as predominantly bitter (and the less sour) ($r_s = -0.63$, p=0.03).

Ethnic differences in taste perception.

We assessed ethnic differences only between African-American and Caucasian populations involved in the study because the group sizes for other ethnicities were too small. African-Americans had significantly higher detection thresholds for $CaCl_2$ (Mann-Whitney, U=49.5, p=0.005; Fig.4) and perceived 25 mM $CaCl_2$ as predominantly sour significantly more frequently than did Caucasians (rated 25 mM $CaCl_2$ as sour at least once, $\chi^2 = 8.79$, $p = 0.003$). African-Americans had significantly higher detection thresholds for sucrose than Caucasians (Mann-Whitney, U=57.5, p=0.03, Fig.4). However, there were no differences in liking or intensity ratings of the sucrose solutions used in the study.

The rate of sour-bitter confusion was significantly higher in African-Americans compared to Caucasians: African-Americans rated 0.25 mM and 2 mM citric acid as predominantly sour less frequently and bitter more frequently than did Caucasians (rated the solutions as bitter at least once : 0.25 mM and 2mM $\chi^2 = 4.04$, df = 1,$p = 0.04$ and $\chi^2 = 10$, df = 1, $p = 0.002$ respectively).

Salivary parameters and taste perception.

There was no relationship between salivary parameters and $CaCl_2$ or sucrose detection thresholds. The variability of $CaCl_2$ detection threshold within our group of subjects was significantly higher than the variability in sucrose detection and ranged from $10^{-8.6}$ M to $10^{-2.3}$ M. Moreover, four of 47 subjects were not able to detect 10 mM $CaCl_2$ which was the highest available concentration. As opposed to what is known about the relationship between salivary concentrations and detection thresholds for other ions (e.g. sodium), detection thresholds for $CaCl_2$ were 3 levels of magnitude below ionized calcium salivary concentrations in 30% of subjects.

There was no relationship between salivary parameters and perception of taste qualities, and liking and intensity ratings of the taste solution tested except for total calcium content which was positively correlated with intensity ratings of low concentrations of citric acid, sucrose, sodium and $CaCl_2$(unstimulated saliva: citric acid: $r_s = 0.36$, p=0.03; sucrose: $r_s = 0.46$,

p=0.004; sodium: r_s = 0.37, p=0.03; $CaCl_2$: r_s = 0.39, p = 0.02 ; stimulated saliva: citric acid: r_s = 0.44, p=0.009; sucrose: r_s = 0.42, p=0.02; sodium: r_s = 0.40, p=0.02; CaCl2: r_s = 0.42, p = 0.01). However, there was also a positive correlation between total calcium concentrations and water taste intensity (unstimulated saliva: r_s = 0.38, p=0.02; stimulated saliva: r_s = 0.40, p=0.02).

Abstracts and presentations

An abstract entitled "Dietary calcium intake and ethnicity may contribute to individual differences in taste perception" has been accepted for presentation at the annual meeting of the Association for Chemoreception Sciences (AChemS) in April 2013, and will be published in the journal, Chemical Senses.

Table 1. Study Sessions Breakdown.

Session #	Measurements	Duration
1	Intensity and liking ratings of four basic taste compounds and calcium of different concentrations paired with the measurement of saliva production, salivary calcium and pH	2 hours
2	Saliva production, salivary calcium and pH before and after calcium supplement or placebo treatment	4.5 hours
3	Calcium chloride ($CaCl_2$) detection thresholds paired with the assessment of daily calcium intake and measurement of saliva production, salivary calcium and pH s	1.5 hours
4	Sucrose detection thresholds paired with the measurement of saliva production, salivary calcium and pH	1.5 hours
5	Saliva production, salivary calcium and pH before and after 1000 mg or 2000 mg of calcium supplement, or placebo treatment	3.5 hours
6	Saliva production, salivary calcium and pH before and after 1000 mg or 2000 mg of calcium supplement, or placebo treatment	3.5 hours
7	Saliva production, salivary calcium and pH before and after 1000 mg or 2000 mg of calcium supplement, or placebo treatment	3.5 hours

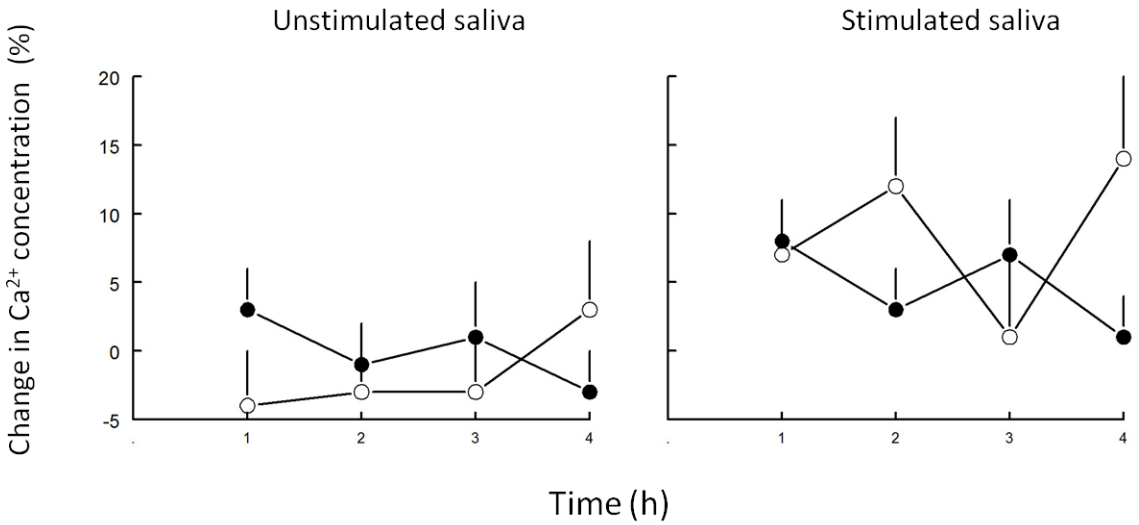

Figure 1. Changes in ionized calcium concentrations in stimulated and unstimulated saliva after 1000 mg calcium supplement (n=20) or placebo treatment (n=20). Data presented as a mean ± SEM of percent of change from salivary calcium concentration at time 0.

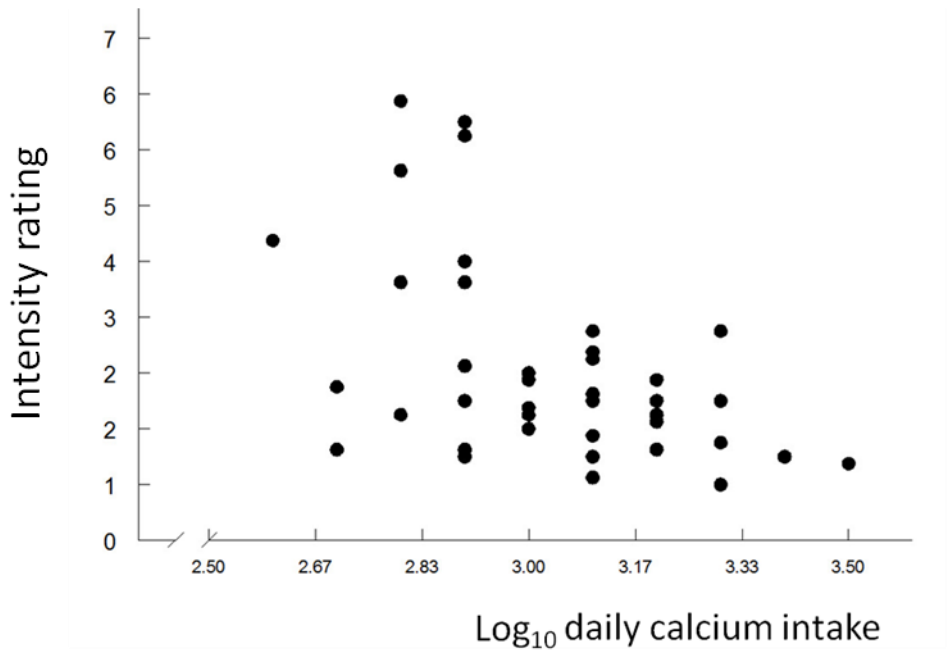

Figure 2. Intensity rating of 10 mM $CaCl_2$ in the whole sample in relation to dietary calcium intake (r_s= - 0.42, p = 0.005).

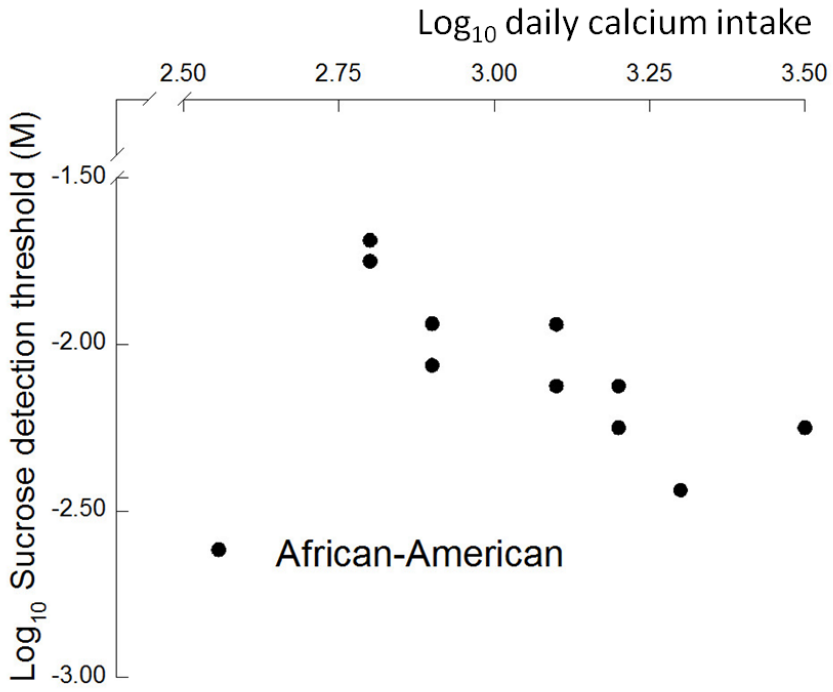

Figure 3. The relationship between dietary calcium intake and sucrose detection in African-Americans, r_s = - 0.93, p<0.001.

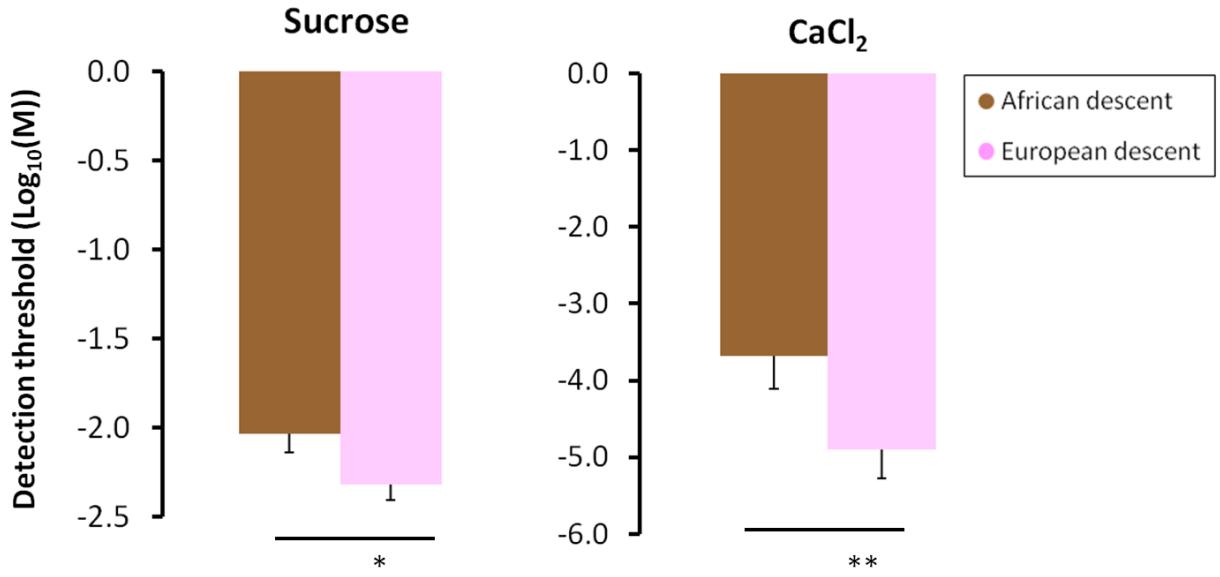

Figure 4. Ethnic differences in sucrose and $CaCl_2$ detection thresholds, * and ** indicate significant differences at p<0.05 and p<0.01 respectively.

18. Extent of Clinical Activities Initiated and Completed. Items 18(A) and 18(B) should be completed for all research projects. If the project was restricted to secondary analysis of clinical data or data analysis of clinical research, then responses to 18(A) and 18(B) should be "No."

18(A) Did you initiate a study that involved the testing of treatment, prevention or diagnostic procedures on human subjects?

_____Yes
X_No

18(B) Did you complete a study that involved the testing of treatment, prevention or diagnostic procedures on human subjects?

_____Yes
_X_No

If "Yes" to either 18(A) or 18(B), items 18(C) – (F) must also be completed. (Do NOT complete 18(C-F) if 18(A) and 18(B) are both "No.")

18(C) How many hospital and health care professionals were involved in the research project?

_____Number of hospital and health care professionals involved in the research project

18(D) How many subjects were included in the study compared to targeted goals?

_____Number of subjects originally targeted to be included in the study
_____Number of subjects enrolled in the study

Note: Studies that fall dramatically short on recruitment are encouraged to provide the details of their recruitment efforts in Item 17, Progress in Achieving Research Goals, Objectives and Aims. For example, the number of eligible subjects approached, the number that refused to participate and the reasons for refusal. Without this information it is difficult to discern whether eligibility criteria were too restrictive or the study simply did not appeal to subjects.

18(E) How many subjects were enrolled in the study by gender, ethnicity and race?

Gender:
_____Males
_____Females
_____Unknown

Ethnicity:
_____Latinos or Hispanics
_____Not Latinos or Hispanics

_____Unknown

Race:
_____American Indian or Alaska Native
_____Asian
_____Blacks or African American
_____Native Hawaiian or Other Pacific Islander
_____White
_____Other, specify:_____
_____Unknown

18(F) Where was the research study conducted? (List the county where the research study was conducted. If the treatment, prevention and diagnostic tests were offered in more than one county, list all of the counties where the research study was conducted.)

19. Human Embryonic Stem Cell Research. Item 19(A) should be completed for all research projects. If the research project involved human embryonic stem cells, items 19(B) and 19(C) must also be completed.

19(A) Did this project involve, in any capacity, human embryonic stem cells?
_____Yes
_X__ No

19(B) Were these stem cell lines NIH-approved lines that were derived outside of Pennsylvania?
_____Yes
_____ No

19(C) Please describe how this project involved human embryonic stem cells:

20. Articles Submitted to Peer-Reviewed Publications.

20(A) Identify all publications that resulted from the research performed during the funding period and that have been submitted to peer-reviewed publications. Do not list journal abstracts or presentations at professional meetings; abstract and meeting presentations should be listed at the end of item 17. **Include only those publications that acknowledge the Pennsylvania Department of Health as a funding source** (as required in the grant agreement). List the title of the journal article, the authors, the name of the peer-reviewed publication, the month and year when it was submitted, and the status of publication (submitted for publication, accepted for publication or published.). Submit an electronic copy of each publication or paper submitted for publication, listed in the table, in a PDF version 5.0.5 (or greater) format, 1,200 dpi. Filenames for each publication should include the number of the research project, the last name of the PI, the number of the publication and

an abbreviated research project title. For example, if you submit two publications for PI Smith for the "Cognition and MRI in Older Adults" research project (Project 1), and two publications for PI Zhang for the "Lung Cancer" research project (Project 3), the filenames should be:

Project 1 – Smith – Publication 1 – Cognition and MRI
Project 1 – Smith – Publication 2 – Cognition and MRI
Project 3 – Zhang – Publication 1 – Lung Cancer
Project 3 – Zhang – Publication 2 – Lung Cancer

If the publication is not available electronically, provide 5 paper copies of the publication.

Note: The grant agreement requires that recipients acknowledge the Pennsylvania Department of Health funding in all publications. Please ensure that all publications listed acknowledge the Department of Health funding. If a publication does not acknowledge the funding from the Commonwealth, do not list the publication.

Title of Journal Article:	Authors:	Name of Peer-reviewed Publication:	Month and Year Submitted:	Publication Status (check appropriate box below):
1. None				☐Submitted ☐Accepted ☐Published

20(B) Based on this project, are you planning to submit articles to peer-reviewed publications in the future?

Yes___X__ No_____

If yes, please describe your plans:

The manuscript is in preparation for publication in Physiology & Behavior or related journal.

21. Changes in Outcome, Impact and Effectiveness Attributable to the Research Project. Describe the outcome, impact, and effectiveness of the research project by summarizing its impact on the incidence of disease, death from disease, stage of disease at time of diagnosis, or other relevant measures of outcome, impact or effectiveness of the research project. If there were no changes, insert "None"; do not use "Not applicable." Responses must be single-spaced below, and no smaller than 12-point type. DO NOT DELETE THESE INSTRUCTIONS. There is no limit to the length of your response.

None.

22. Major Discoveries, New Drugs, and New Approaches for Prevention Diagnosis and Treatment. Describe major discoveries, new drugs, and new approaches for prevention,

diagnosis and treatment that are attributable to the completed research project. If there were no major discoveries, drugs or approaches, insert "None"; do not use "Not applicable." Responses must be single-spaced below, and no smaller than 12-point type. DO NOT DELETE THESE INSTRUCTIONS. There is no limit to the length of your response.

Our data demonstrate that dietary calcium intake is associated with perception of sweet and sour taste compounds. This is a novel finding that may have implications in management and prevention of metabolic diseases.

23. Inventions, Patents and Commercial Development Opportunities.

23(A) Were any inventions, which may be patentable or otherwise protectable under Title 35 of the United States Code, conceived or first actually reduced to practice in the performance of work under this health research grant? Yes_____ No___X

If "Yes" to 23(A), complete items a – g below for each invention. (Do NOT complete items a - g if 23(A) is "No.")

a. Title of Invention:

b. Name of Inventor(s):

c. Technical Description of Invention (describe nature, purpose, operation and physical, chemical, biological or electrical characteristics of the invention):

d. Was a patent filed for the invention conceived or first actually reduced to practice in the performance of work under this health research grant?
Yes_____ No____

If yes, indicate date patent was filed:

e. Was a patent issued for the invention conceived or first actually reduced to practice in the performance of work under this health research grant?
Yes_____ No____
If yes, indicate number of patent, title and date issued:
Patent number:
Title of patent:
Date issued:

f. Were any licenses granted for the patent obtained as a result of work performed under this health research grant? Yes_____ No____

If yes, how many licenses were granted?_____

g. Were any commercial development activities taken to develop the invention into a commercial product or service for manufacture or sale? Yes___ No____

If yes, describe the commercial development activities:

23(B) Based on the results of this project, are you planning to file for any licenses or patents, or undertake any commercial development opportunities in the future?

Yes_____ No___X___

If yes, please describe your plans:

24. Key Investigator Qualifications. Briefly describe the education, research interests and experience and professional commitments of the Principal Investigator and all other key investigators. In place of narrative you may insert the NIH biosketch form here; however, please limit each biosketch to 1-2 pages. *For Nonformula grants only – include information for only those key investigators whose biosketches were not included in the original grant application.*

BIOGRAPHICAL SKETCH

Provide the following information for the Senior/key personnel and other significant contributors in the order listed on Form Page 2.

NAME Anna Y Voznesenskaya	POSITION TITLE Postdoctoral fellow
eRA COMMONS USER NAME (credential, e.g., agency login)	

EDUCATION/TRAINING *(Begin with baccalaureate or other initial professional education, such as nursing, include postdoctoral training and residency training if applicable.)*

INSTITUTION AND LOCATION	DEGREE *(if applicable)*	MM/YY	FIELD OF STUDY
Lomonosov Moscow State University, Moscow, Russia	MS(Hons)	06/2005	Human & Animal Physiology
Kharkevich Institute for Information Transmission, Moscow, Russia	PhD	06/2009	Physiology & Bioinformatics

A. Personal Statement

My background is in the chemosensory sciences, with my early research focusing on mechanisms of odor perception in rodents. In 2010, I started postdoctoral training with Dr. Tordoff as my advisor at Monell Chemical Senses Center. For the last 2.5 years, I have been researching into the physiological and genetic basis of mineral consumption, focusing on calcium and sodium taste and intake in both humans and rodents.

Employment

2009 - 2010 Junior Researcher, Kharkevich Institute for Information Transmission, Moscow, Russia

2010 - Postdoctoral fellow, Monell Chemical Senses Center, Philadelphia, PA

Professional association memberships

2004-2009	European Chemoreception Research Organization
2007, 2009-current	Association for Chemoreception Sciences
2010, 2012	Society for the Study of Ingestive Behavior

B. Publications

1. Voznesenskaya A, Tordoff MG (2013) Influence of estrous and circadian cycles on calcium intake in the rat // Physiology & Behavior (in press)

2. Golden GJ*, Voznesenskaya A*, Tordoff MG (2012) Chorda tympani nerve modulates the rat's avoidance of calcium chloride // Physiology & Behavior 105 (2012), pp. 1214-1218
3. Voznesenskaia A.E. (2009) The Influence of Emotional Stress on Reception of Sex Pheromones in House Mouse // *Sensornie sistemy* (Sensory systems), 23(1): 61-66 (in Russian).
4. Voznesenskaia A.E., Klyuchnikova M.A., Voznessenskaya V.V.. (2006) The influence of predator odors on maternal behavior in rodents // Nauchnie Trudi MPGU, pp. 374-377, Moscow.
5. Ambaryan A.V., Voznesenskaia A.E. (2006) Mechanisms of Reproductive Isolation in House Mouse (Mus musculus s.lato) // Proceedings of Young Scientists Conference, IEE RAS, Moscow, pp. 4-10.
6. Voznesenskaia A (2009). Influence of stress on female chemosensory cues perception in house mouse. Frontiers in Human Neuroscience. Conference Abstract: Summer School on Human Olfaction. doi: 10.3389/conf.neuro.09.2009.12.027
7. Voznesenskaia A.E., Minor A.V. (2009). Reception of sex pheromones in House Mouse is affected by exposure to stress // Chemical Senses. 34(3). E33.
8. Ambaryan A.V., Voznesenskaia A.E., Kotenkova E.V., Voznessenskaya V.V. (2009) Chemical Signals may play a critical role in reproductive isolation of closely related Mus species // Chemical Senses. V.34(3). E.65.
9. Voznesenskaia A.E. (2008) Exposure to Stress Affects Reception of Sex Pheromones in House Mouse. .// Chemical Senses. 33(8). S.48.
10. Voznessenskaya V.V., Klyuchnikova M.A., Voznesenskaia A.E. (2007) The Role of Vomeronasal Organ in Mediating Responses to Predator Odor // Chemical Senses. 32(6). A.33-34.
11. Voznesenskaia A.E. (2006) The role of Hormonal Status of Signal Recipient in Pheromone Reception in House Mouse // Chemical Senses, 31(8). E24-25.
12. Voznessenskaya V.V., VoznesenskaiaA.E., Klyuchnikova M.A. (2006) The Role of Vomeronasal Organ in Reception of Predator Scents // Chemical Senses, 31(8), E.43-44.
13. Voznesenskaia A.E., Ambaryan A.V., Kotenkova E.V., Voznessenskaya V.V. (2005) The role of Chemical Cues in Reproductive isolation of closely related Mus species. // Chemical Senses, 30(2), E55.