

## HOW TO WRITE A SCIENTIFIC LABORATORY REPORT

The reports are to be presented in a descriptive format, based upon an experiment that is approved in the Course Outline (designated by #) or, if an extra-credit, self-designed experiment, approved by the instructor. Assume that the reader has little background regarding specifics of your experiment, but has a general knowledge and interest in the subject matter. The format should be similar to basic scientific papers, and have a descriptive **TITLE** at the top of the first page. The title should briefly describe what your experiment is about.

The body of the paper should begin with an **Introduction** (brief background about the topic- including any appropriate literature citations\*, what you plan to do and why; in other words, present a **hypothesis** and explain how you go about testing it). The introduction should be brief - 2 paragraphs long (refer to sample lab report).

The introduction is to be followed by a **Materials and Methods** section (all pertinent equipment, chemicals, and basic procedures). If properly cited, references to the lab manual(s) may also be made here, to reduce your writing (*see the attached sample of a lab report for an example*).

The 3rd section is the **Results** section (a paragraph or two describing your data along with Tables &/or Figures, upon which you base your written descriptions in text (**note: you must refer to each table / figure in the written results section**)). Tables and figures are numbered separately followed by the title of each table/figure (e.g. Table 1. Height and weight of 22 physiology students).

The 4th section of your paper will be a **Discussion**, in which you make conclusions based upon your data and personal observations &/or recommendations for further study. Furthermore, the discussion should include any citations which would help to support your conclusions\*.

Lastly, include a **Literature Cited** section. This is an alphabetical author list of references which you cited in the body of your paper at appropriate locations. You are required to use the **APA** (American Psychological Association) **Style**, which recommends an author-date style of in-text citations (e.g. place the citation at the end of a sentence in which you make a statement of fact or previous research which supports your statement). These citations refer readers to a complete list of references at the end of your paper. APA in-text citations provide the author's last name and the date of publication. For direct quotations, a page number is given as well. Examples of various types of citations (books, journals, multiple authors, documenting electronic sources - the internet, etc) may be found by logging onto the Internet and opening the following Web site: **Apastyle.org**. This site will be reviewed in class. A sample of the literature cited section is given in your Sample Lab Report and Style-Samples handout (attached).

OUTLINE OF YOUR REPORT:

TITLE

I. Introduction\*

II. Materials & Methods (incl. numbered Tables &/or Figures)

III. Results

IV. Discussion\*

V. Literature Cited (alphabetical by author)

Refer to the Sample of a Laboratory Report on the following pages for more details about structuring of your paper.

\* Literature citations are generally found in the introduction and the discussion. They are used to provide more background and support any conclusions made in your paper.

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**A Checklist for Completeness and Consistency**

- Is the paper typewritten and double-spaced and based on an approved exercise from your Course Schedule or an approved "extra-credit" expt?
- Are all required sections present? (*automatic 5 pt deduction for each missing section*)
- Is the title specific and informative?
- Does the Introduction state your main objectives, background with references and an hypothesis/hypotheses?
- Have you included enough information in the Materials & Methods section to enable someone else to repeat your study?
- Have you explained in Materials & Methods the procedures for collecting all the data presented in the Results, or referenced other sources if your procedures are not written out?
- Are figures (graphs or diagrams) and tables numbered consecutively in separate series and titled completely?
- Is every figure and table cited in the text of your paper (in results section)?
- Do the data in each figure or table agree with your in-text results & discussion?
- Are data in related figures or tables shown in a consistent manner?
- Is each table and figure understandable without having to refer to the text of your paper?
- Are all relevant Results included (are the necessary Tables & Figures included)?
- Have you used the proper headings for each section in the correct order?
- Does the Discussion address the major implications of your findings?
- Does the Discussion address problems and inconsistent results that may have arisen?
- Have you cited all necessary sources (minimum of 3)?
- Are all citations properly referenced, using APA format in the text & Literature Cited section?
- Does the Literature Cited section contain any references that you forgot to cite in the text?
- Are your literature citations listed in alphabetical order by author (refer to APA Style Samples handout)?

## **SAMPLE LAB REPORT**

*Directions : Follow this format when making your rough draft & final report*

Biology 220,  
Human Physiology

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### **Bile Salts Enhance Lipase-Digestion of Fats**

#### Introduction

The pancreas secretes various enzymes into the small intestine. One of these enzymes, pancreatic lipase, digests dietary fats into products such as glycerol and fatty acids (Mader, 1995). However, fat is insoluble in water-based chyme (liquefied food processed by the stomach); and in the intestines the fats cling together, providing little surface area for attachment of the enzymes. This prolongs the time it takes the lipase to digest the fat.

In order to speed up the fat digestion process, bile salts, secreted by the gall bladder into the small intestine, act as a detergent which break up the fat droplets in the watery chyme thus increasing the surface area for enzymatic digestion by lipase (Martini & Timmons, 1997). In other words, bile is an emulsifying agent. Emulsification of fats is achieved upon exposure to bile salts, which allow pancreatic lipase to digest the fat more efficiently. In order to demonstrate that bile salts enhance the digestion of fats, we tested for the digestion of milk fat by pancreatic lipase in the presence and absence of bile salts.

#### Materials and Methods

Three groups of test tubes were set up; 3 replicates were set up in each group in order to provide an adequate sample size.

To each group of 3 test tubes the following were added:

**Group 1:** 3.0 ml of whole milk + 5.0 ml of water + 3 grains of bile salts

**Group 2:** 3.0 ml of whole milk + 5.0 ml of pancreatin solution (*see below for concentration*)

**Group 3:** 3.0 ml of whole milk + 5.0 ml of pancreatin solution + 3 grains of bile salts

Dehydrated pancreatin, derived from pig pancreas was reconstituted in water (@ 1 g/100ml) immediately before using. This solution contained the pancreatic lipase enzyme which was used to digest the milk fats. Dried grains of bile salts, derived from the pig gall bladder, were dissolved directly in each test tube (see above).

In order to determine the increase in fatty acid end-products during the digestion of fats, we tested pH of the incubated solutions (as fatty acid concentration increases, pH decreases). The pH of each test tube was determined at time zero (beginning of the expt.) using "short range" pH paper (reads pH 6-10). The test tubes were incubated at 37 C for 1 hour. During that hour, the pH was tested every 20 min.

### Results

The pH did not decrease during the 60 minute incubation period in the negative control group #1 which only contained milk and bile salts (Table 1). In groups #2 & #3 the pH did decrease as the digestion of fats progressed and fatty acids built up in the test tubes. After 20 minutes the pH decreased in group 2 from 8.5 to 7.5, while there was a greater change in tube 3 (from pH 8.5 to 7.0). At 40 min incubation, the pH of the solutions in both groups #2 & #3 had dropped to 6.5 and did not decrease further at 60 minutes. The data for all 3 groups is visually plotted in Figure 1 (attached).

Table 1: Mean\* pH of whole milk during incubation with bile salts &/or pancreatin

Time (min.)	Group 1 (+ B.S. <sup>1</sup> )	Group 2 (+ pancreatin)	Group 3 (+ B.S. + pancreatin)
0	pH 8.3	8.5	8.5
20	8.4	7.5	7.0
40	8.3	6.5	6.5
60	8.3	6.5	6.5

\* mean pH of 3 sample tubes per group

<sup>1</sup> Bile Salts

### Discussion

The negative control tube which only contained bile salts and milk, did not exhibit a pH change. Therefore, it was concluded that bile salts alone did not digest milk fats.

Digestion of milk fats occurred in tubes 2 and 3, based on the observation of fatty acid by-product accumulation, as measured by a decrease in pH. However, the production of fatty acids occurred faster in group #3 as evidenced by the data at 20 minutes. This suggests that something present in the solution of group #3 aided in the digestion of the fats. Since the concentration of pancreatin was identical in both groups #2 & #3, the addition bile salts must have contributed to the digestion of the fats by breaking up those fat droplets into smaller particles which increased the availability of substrate in group #3. The action of bile salts enhanced the rate of the lipase-fat digestion. The data from tube #1, as a negative control, demonstrates that bile salts do not digest fats; therefore, bile salts must only act to emulsify the fats thus enabling pancreatic lipase to act more efficiently. This conclusion is also supported by work done by Patton & Carey (1979) and reported in an article by Bowen (1996) that was posted on the Internet.

We also determined that either the enzymatic activity of pancreatic lipase is inhibited below pH 6.5, or that the fat substrates were depleted by 40 minutes in tubes 2 and 3, since there was no change in pH between 40 and 60 minutes. Further experimentation will reveal which of these two possibilities occurred. Fox (1996) reported that the optimal activity of pancreatic lipase occurs at a pH of 8. Therefore, it is most likely that the lack of change in pH between 40 and 60 minutes in tubes 2 and 3 was due to the fact that the accumulation of fatty acid end products produced an excessively acidic environment (pH 6.5 at 40 minutes), thereby inhibiting further enzyme activity. This may suggest that pancreatic lipase is denatured in weakly acidic conditions between pH 7.0 and 6.5. However, if this is not the case, then an alternative conclusion may be that depletion of substrate occurred during the experimental period. This experiment should be re-run using cream or vegetable oil which contain significantly more fat than whole milk.

Literature Cited                   *(APA format must be used here)*

Bowen, R. 1996. Absorption of Lipids. Website at URL: [http://www.arbl.cvmbbs.colostate.edu/hbooks/pathphys/digestion/smallgut/absorp\\_lipids.html](http://www.arbl.cvmbbs.colostate.edu/hbooks/pathphys/digestion/smallgut/absorp_lipids.html).

Fox, S.I. 1996. Lab Guide - Human Physiology, Concepts and Clinical Applications. 7th ed. W.C. Brown, Dubuque, IA.

Mader, S.S. 1995. Human Biology, 4th ed. W.C. Brown, Dubuque, IA.

Martini, F.H. and M.J. Timmons. 1997. Human Anatomy. 2nd ed. Prentice Hall, Upper Saddle River, NJ.

Patton, J.S., Carey, M.C. 1979. Watching fat digestion. Science 204: 145.

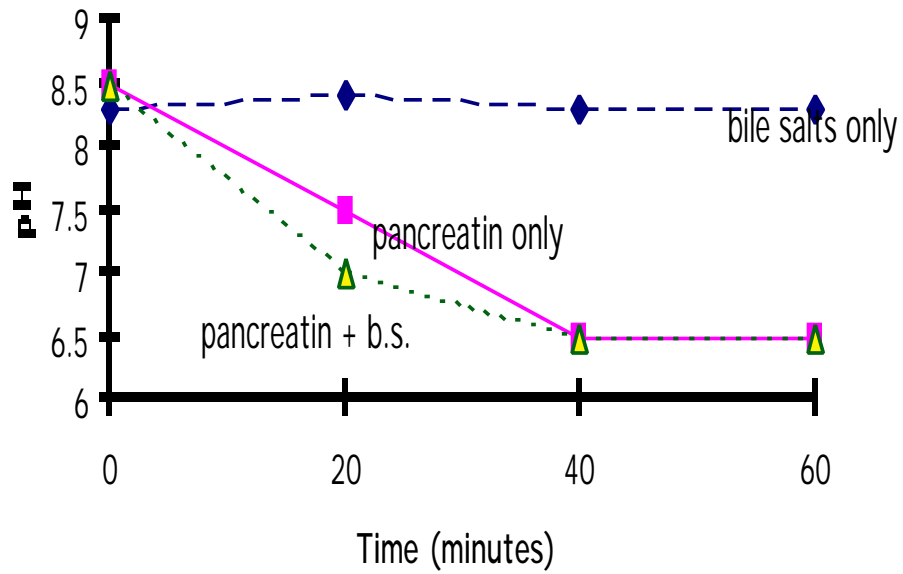


Figure 1. Mean pH of whole milk during incubation with bile salts &/or pancreatin