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Food Acceptability as Affected by Fluorescent Lighting

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To the Graduate Council:

I am submitting herewith a thesis written by Janice Ward Pafford entitled "Food Acceptability as Affected by Fluorescent Lighting." I have examined the final electronic copy of this thesis for form and content and recommend that it be accepted in partial fulfillment of the requirements for the degree of Master of Science, with a major in Nutrition.

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Vice Provost and Dean of the Graduate School

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July 27, 1973

To the Graduate Council:

I am submitting herewith a thesis written by Janice Ward Pafford entitled "Food Acceptability as Affected by Fluorescent Lighting." I recommend that it be accepted for nine quarter hours of credit in partial fulfillment of the requirements for the degree of Master of Science, with a major in Institution Administration.

Mary J. Hitchcock
Major Professor

We have read this thesis and recommend its acceptance:

Bernadine Meyer

[illegible]

Accepted for the Council:

Vice Chancellor for
Graduate Studies and Research

FOOD ACCEPTABILITY AS AFFECTED BY FLUORESCENT LIGHTING

A Thesis

Presented to

the Graduate Council of

The University of Tennessee

In Partial Fulfillment

of the Requirements for the Degree

Master of Science

by

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ABSTRACT

This research was conducted to investigate food acceptability as affected by warm and cool fluorescent lights. Five food items were judged by college students on a cafeteria hot food line in Presidential Court Food Service at The University of Tennessee Knoxville. Choices of roast beef, hamburgers, green beans, mashed potatoes, and mixed vegetables held under cool and warm fluorescent lights were recorded.

All five foods lighted by a warm fluorescent tube were chosen in preference to the same foods lighted under a cool fluorescent light. The food preferences were significant at the 5% level between the two fluorescent lights when roast beef, hamburgers, mashed potatoes, and green beans were judged as determined by a chi square analysis.

Constructive criticism was offered by the students. Numerous negative remarks were made about all the foods under the cool fluorescent light source. This light source seemed to cast a green hue on all foods, especially meats. Others felt the roast beef and mixed vegetables appeared artificial under the cool fluorescence. Many complimentary comments were made about the foods under the warm fluorescent light source.

From the results of this study, it was concluded that food items appear different under a warm fluorescent tube as compared to being lighted by a cool fluorescent source. This research indicates that it could be possible to increase sales of prepared food served in volume by using warm fluorescent lights in serving and dining areas.

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CHAPTER I

INTRODUCTION

Humans associate color with physical objects which are in contrast with their environment as the golden yellow of whole kernel corn piled on a white plate (General Electric, 1968). Color is not a physical property of the objects we see, but simply the effects of light waves bouncing off or passing through various objects. The characteristics of the light source under which it is viewed and the way in which the object absorbs, transmits, or reflects the light waves determines the color of an object. Evans (1965) defines color as the psychophysical concept received by an observer when he evaluates a physical stimulus in terms of hue, saturation, and brightness.

The quality of food is generally judged on the basis of color, flavor, texture, and nutritive value (Clydesdale, et al., 1970; Francis, 1970). Many believe the most important quality attribute of food is color. People in the United States purchase large quantities of beef yearly using color as the major quality attribute (Clydesdale, et al., 1971). Sometimes the color of an object is used as an indicator of other properties which it may possess (Wright, 1969). Shoppers use the color of fruit as a guide to its sweetness. No matter how nutritious or flavorful a product is, it will never be eaten unless it is the "right" color (Clydesdale, et al., 1970). Color is always a part of food. It is the visual element to which people's eyes, minds, and emotions are sensitive (Birren, 1963). In countless foods, people demand the "right" color and will accept or reject a product on its appearance alone (Judd, 1952; Birren, 1963). Bread crust which is too dark may be considered burnt. Tomatoes having too green a color are considered unripe. Suarez-Solis (1965) feels light and color definitely influences food sales.

In 1960, Nickerson (1960) stated a concern about the color rendering properties of many new efficient light sources. Since then, individuals have conducted research concerning the effect of light on color (Helson, et al., 1956; Helson, et al., 1970; Francis, 1970; Billmeyer, et al., 1966; Borsenik, 1965).

The purpose of this research was to develop a method of evaluating acceptability of food served on a cafeteria steam table as affected by lighting. The results of this research could be used by various professional people (architects, interior designers, marketing specialists, and food service consultants) to aid food services in designing areas that would promote high food acceptability.

CHAPTER II

REVIEW OF LITERATURE

I. PSYCHOLOGICAL ASPECTS OF COLOR

Colors have psychological effects upon individuals (Francis, 1970; Birren, 1969; Suarez-Solis, 1965). When a person sees a color, he automatically has definite reactions expressed as likes, dislikes, pleasant, or unpleasant associations (Birren, 1969; Hill, 1969; Jacobson, 1948; Wilson, 1960). The relationship between color and the emotional reactions that it produces it not clearly understood (Evans, 1965). Research on the psychological aspects of color is difficult because human emotions are inconsistent (Birren, 1961). The psychic make-up of individuals varies from person to person. Many experiments concerning color psychology have lacked good scientific control (Birren, 1969). Color preference tests have been completed in such a variety of ways that comparisons are almost impossible (Guilford, 1934).

Not all persons will "feel" the same about colors or have the same reactions (Birren, 1963). Colors of foods involve personal and emotional interpretation. The peak of food color pleasure is reached in the red-orange and orange region of the spectrum. These hues seem to arouse more agreeable hunger sensations. Color and color rendition are functions of individual preferences and light sources (General Electric, 1968). Color corresponds in acceptability to the level of discrimination a person has to a color (Campbell-Smith, 1970).

The many psychological aspects which can influence human judgment of a color are called "esthetics" (Francis, 1970). The individual esthetic sense of color appreciation depends upon the following factors: race, nationality, sex, age, education, geographical location, and others. People usually have a preconceived idea as to the color certain foods should have. For example, people might reject butter if it had a greenish hue.

II. LIGHTING CHARACTERISTICS

When determining whether or not a given luminous environment will or will not be acceptable to the majority of people, light sources cannot be considered apart from the objects they illuminate (Helson, et al., 1970). A given source of illumination may be favorable for some colors and not for others. If general principles governing the aesthetic effects of various light sources could be determined, it would be possible to choose the best source for a given interior.

Warm Fluorescent Light

Some lights tend to "flatter" object colors (General Electric, 1968). They emphasize the dominant color of the object while deemphasizing complementary colors. For example, a warm white fluorescent light will bring out warm object tones. This light emphasizes yellow, orange, and brown while it dulls red, green, and blue (General Electric, 1970; Buck, et al., 1947). A warm white fluorescent light tends to emphasize sallowness in complexion tones. It has a fair color rendering index of fifty-two out of a hundred (Allen, 1971). A warm white fluorescent light has a yellowish-white appearance on neutral surfaces (General Electric, 1968).

Cool Fluorescent Light

A cool white fluorescent source has a neutral to moderately cool effect on "atmosphere." This light source emphasizes blue, green, yellow, and orange but dulls red (General Electric, 1970; Allen, 1971; Buck, et al., 1947). A cool white fluorescent bulb has a reasonable color rendition of sixty-five out of a hundred. A complexion is usually a pale pink under this light source (General Electric, 1968). The cool fluorescent light appears to be white on neutral surfaces. A cool fluorescent light is a popular light source for active work areas where color is not critical (General Electric, 1970; Allen, 1971).

General Fluorescent Properties

The following are important elements in lighting effect to consider when choosing a fluorescent lamp color: luminous efficacy (lumen output per watt input), color rendition, and whiteness (General Electric, 1973). The choice among "fluorescent whites" always involves a compromise among these three items. Cool white and warm white lamps are designed for highest efficacy consistent with acceptable color rendition for most applications. Nickerson (1960) states that the spectral distribution of the energy curve in the visual portion of the spectrum of a light source determines its color rendering properties. This is illustrated when one compares the spectral radiation curves of cool and warm fluorescent lights (Figures 1 and 2). The same object

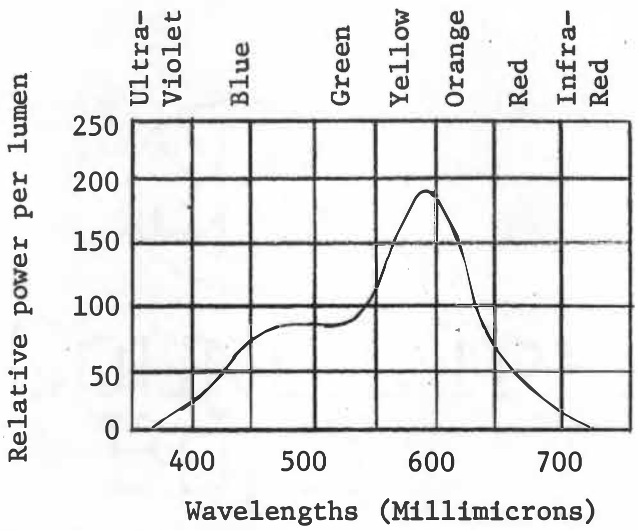

Figure 1. Spectral radiation curve of a cool fluorescent light.

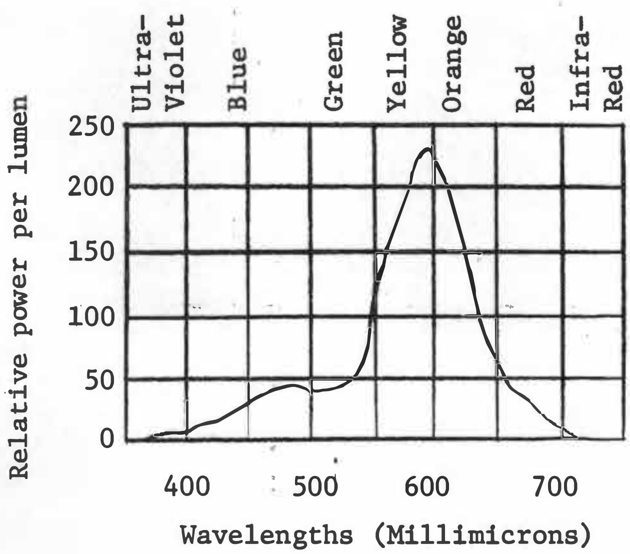

Figure 2. Spectral radiation curve of a warm fluorescent light.

General Electric, 1970

may have different colors when seen by the same observer under different light sources (Billmeyer, et al., 1966).

Small departures from color constancy of illuminated objects are quite common with fluorescent lights (Wright, 1969). They have frequently been criticized on account of these color distortions. The unsatisfactory color rendering arises from the abnormal spectral distribution which fluorescence possesses.

III. EXPERIMENTATION WITH LIGHT AND COLOR

Food Under Fluorescent Lamps

Some successful restaurants with a flair for showmanship and good food have chefs in white hats carve roast beef in full view of their patrons under warm fluorescent lights (Francis, 1970). Since the managers know cool white fluorescent lights degrade the appearance of the meat, it is used very little. Birren (1963) stated that research in the lighting field has confirmed that people at large prefer warmth in illumination. This author concluded that warm lights in a food service was imperative.

Borsenik (1965) researched the effect of eleven different light sources on eight commonly eaten foods. The foods were presented for testing in blackboard black chambers. Among the eleven light sources tested in the chambers were cool white and warm white fluorescent tubes. The panel consisting of university faculty, students, and personnel recorded their impressions of the foods' appearance on a nine point scale ranging from like extremely to dislike extremely. Neither the warm nor cool fluorescent light was preferred by the panel when judging roast beef but the cool white light was preferred over that produced by a warm white fluorescent lamp. Both cool white and warm white fluorescent lamps were highly preferred when green peas and mashed potatoes were scored. Yet, the warm white fluorescent source was chosen over the cool white fluorescent lamp in both food items. When the scores were computed, an incandescent light source was rated number one by the panel. Warm white and cool white fluorescent lamps received final ranks of fourth and fifth, respectively.

An experiment was conducted to find the pleasantness rating of five foods and two complexions under five sources of illumination (Helson, et al., 1970). The rating was done by four women and six men. Two of the light sources were a warm and cool fluorescent light. The overall results according to the F-test were highly significant statistically for the five sources in the case of each sex. The spectral energy of the light sources affected reactions to foods and complexions to a significant degree. The women preferred butter, raw beef, and an apple in a cool fluorescent light. The men found all foods except butter most pleasant under an incandescent light source. Men and women agreed that one of the poorest light sources was the warm fluorescent light.

Another research project used the same five sources of illumination to test food preferences for four food items (Francis, 1970). The panel rated each food for the most and least preferred light source. Women preferred butter and raw beef under a cool white fluorescent light. The men least preferred butter, raw beef, and tomatoes under a warm fluorescent light. Tomatoes were least preferred under the warm fluorescent light by the women.

Color Samples Under Fluorescent Sources

Helson et al. (1970) studied sex differences in effects of illumination sources on pleasantness ratings of colors. Differences between the sexes were highly significant. Men preferred the cool fluorescent light sources while the women tended to prefer the warmer light sources. Helson recommended a cool white fluorescent lamp as a "safe" light source enabling all backgrounds to enhance object colors.

Wilson (1960) researched the color changes of various pigments under different light sources. Matt pastel colors were viewed under a June daylight and the color was noted. Then a comparison was made under a warm white fluorescent light. A cream color appeared to deepen in color under the warm white fluorescent light. Green became slightly duller and yellowed while a blue color seemed grayed and duller.

Five psychology students were trained to test Munsell color samples in a light-tight booth with gray cardboard walls (Helson, et al., 1956). The standard light source was a Macbeth daylight lamp and three fluorescent lights were used as variants. It was found that all color samples under the Macbeth daylight lamp had a "mean hue color change" when placed under the various fluorescent lights. For example, a sample under the standard light source was green. When placed under a warm fluorescent light, the color sample had a 0.74 observed mean hue color change toward yellow. When the color change was calculated for green, it was stated to be 1.17 bluer under the warm fluorescent light. The green sample under the cool fluorescent light had a 0.05 bluer observed color change but a 0.41 bluer calculated color change. A green-yellow ample under the Macbeth daylight source was observed to be 0.05 more yellow under the warm fluorescent light but 1.25 greener under the cool fluorescent lamp. This illustrates that the same object does look different when under the two types of fluorescent lights employed in the present study.

In reviewing the literature, the effect of light on the color of food has not been thoroughly investigated. Since the color of food affects its acceptability, more research is needed in the area of how lighting might affect food acceptability which in turn affects income for a food service.

CHAPTER III

PROCEDURE

The purpose of this research was to develop a method of evaluating the effect of lighting on the acceptability of food served on a cafeteria steam table.

The Presidential Court Food Service at The University of Tennessee Knoxville was used as the experimental laboratory for this research. Student choices of foods held under cool and warm fluorescent lights were observed.

I. THE CAFETERIA LINE

One hot food counter at Presidential Court Food Service was sectioned into six hot food lines as illustrated in the schematic drawing on the following page (Figure 3). There were two separate serving areas located on either side of the production area. Each area contained one hot food counter. Sample observations were taken from both sides. Observations were made using only one hot food line at a time.

During the meal hours, the serving area was lighted by recessed louvered fixtures. Twenty-five watt incandescent bulbs were located under the shelf of the cafeteria hot food counter to highlight the food. Since the concern of this research was to study the effect of an undershelf highlight on food acceptability, all other lighting was eliminated as much as possible. An end hot food line (Line 1 or 6 on

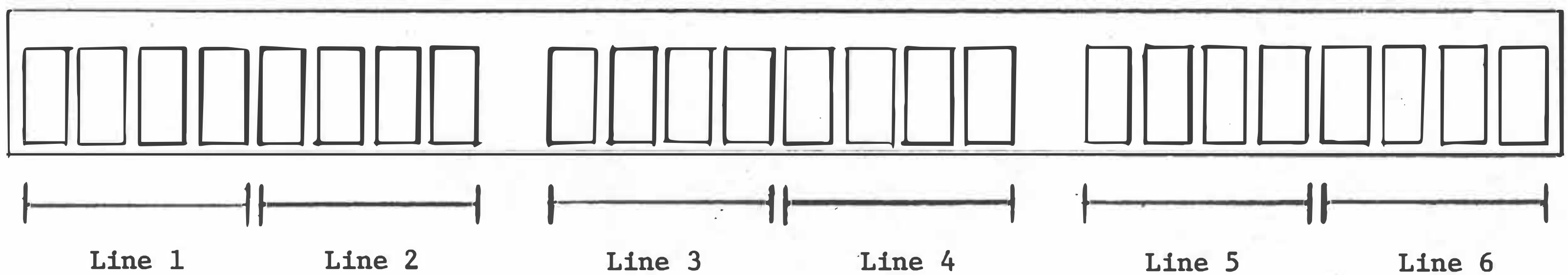

Figure 3. Hot food counter divided into serving lines.

Figure 3) was used for the experiments since the hot food lines on each end received minimum ceiling light.

II. LIGHTING MODULE

To reduce the ceiling light effect upon the experiments, a custom made plywood box structure was set over each counter pan containing the experimental food. This box was painted black to absorb the light rays that could interfere with the experiments. The sides of the box were the same length as each counter insert (twenty-five inches). The top of the box was the width of the counter insert but half the length of the counter insert (twelve inches). The sides of the box slanted from the end of the top to the end of the insert for ease of food replacement (see Figure 4). Under the top of each box structure, a twelve inch under-the-counter fluorescent tube and adapter were installed. These fluorescent tubes were equivalent to a twenty-five watt bulb in lumen output. One box contained a cool white fluorescent tube, while the other box held a warm white fluorescent tube.

III. OBSERVATIONS AND PROCEDURES

The food selected for the experiment was the food normally prepared by the cooks at Presidential Court Food Service using a four week cycle menu which provided a similar appearance of the food for each test. Food chosen for the experiments appeared at least once a week. The selected food items were roast beef, hamburgers, mixed vegetables, mashed potatoes, and green beans. Two pans of each food

Figure 4. Lighting modules.

item were tested at one time. One pan was illuminated by a warm white fluorescent tube and the other pan was lighted by a cool white fluorescent tube. The experimental food was contained in standard half counter steam table pans.

Observations of food choices were made each time the selected foods (roast beef, hamburgers, mashed potatoes, green beans, mixed vegetables) were offered on the cycle menu. The mobile box forms were placed over the food pans before the serving hours of the meal started. The type of light positioned first in the line was changed each time the same food item was tested to eliminate positional bias. The test continued until the number of servings determined in the pilot study had been obtained (350 for roast beef, 100 for mixed vegetables, 625 for mashed potatoes, 20 for hamburgers, and 530 for green beans). If two of the selected foods were offered at the same meal, only one was tested due to the limited number of inserts for the hot food line. Food servers were instructed as to how to answer questions concerning these experiments.

A poster announcing the experiment was posted at the entrance to the food service area. It was taken down at the close of each experiment. An observer noted the selection of the food items on a check sheet (in the Appendix). An alternate observer was trained to perform all duties in the event that the main observer could not be present.

IV. PILOT STUDY

A pilot study was conducted at Presidential Court Food Service to determine a valid number of observations needed and to foresee problems that might occur. Table 1 illustrates the results from this study. From these results, the power of the test was set at 0.80 and the alpha risk at 0.10.

Table 1. Entree and Vegetable Acceptability as Affected by Warm and Cool Fluorescent Lights*

Food	Total Number Observations	Number of Selections Under Warm Fluorescent Light	Number of Selections Under Cool Fluorescent Light
Roast Beef	76	44	32
Hamburgers	41	34	7
Mixed Vegetables	43	28	15
Mashed Potatoes	75	42	33
Green Beans	122	69	53

*Results of pilot study only.

CHAPTER IV

RESULTS AND DISCUSSION

The null hypothesis for this research was that there will not be any differences in the acceptability of food produced in volume when held under a cool fluorescent or warm fluorescent light. The testing procedures were conducted in Presidential Court Food Service at The University of Tennessee Knoxville. Observations were made of individual selections of roast beef, hamburgers, mixed vegetables, mashed potatoes, and green beans on a cafeteria hot food line. The students chose the selected food items from half counter pans lighted by a warm or cool fluorescent light source.

I. SELECTION OF FOODS

Meat Selections

Results of the food choices under the warm and cool fluorescent light were recorded (see Table 2).

Selections from under the warm fluorescent light for roast beef and hamburgers were 78.0% and 90.0%, respectively. The natural brown color of the roast beef and the hamburgers could have been the reason for their selections under the warm fluorescent light. Light sources will "flatter" an object color by emphasizing the dominant color of the object (General Electric, 1968). One of the colors a warm fluorescent light does emphasize is brown (General Electric, 1970; Buck, et al., 1947). Francis (1970) stated that restaurants often

Table 2. Acceptability of Selected Entrees and Vegetables Under Warm and Cool Fluorescent Lights

Food	Total Number Observations	Number of Selections Under Warm Fluorescent Light	Number of Selections Under Cool Fluorescent Light
Roast Beef	350	273(78.0%)	77(22.0%)
Hamburgers	20	18(90.0%)	2(10.0%)
Mixed Vegetables	101	59(58.4%)	42(41.6%)
Mashed Potatoes	625	415(66.4%)	210(33.6%)
Green Beans	530	320(60.4%)	210(39.6%)

carved roast beef under warm fluorescent lights because a cool fluorescent light degraded the appearance of the meat. Judges in an experiment conducted by Borsenik (1965) preferred the cool white fluorescent light over the warm white fluorescent source when judging roast beef. The hamburgers had a 12% higher selection ratio under the warm fluorescent light than the roast beef. This can probably be attributed to the spectral radiation distribution of this fluorescent source emphasizing the deeper brown color of the hamburger.

Vegetable Selections

Selections from under the warm fluorescent light for mixed vegetables, mashed potatoes, and green beans were 58.4%, 66.4%, and 60.4%, respectively. Mixed vegetables did have the lowest selection ratio for all foods under the warm fluorescent light.

It was difficult to make a choice between the two types of fluorescent lights for mixed vegetables because of the mixture of colors present (yellow, orange, green). The green was emphasized by the cool fluorescent light, and yellow was accentuated by both fluorescent sources (General Electric, 1970; Buck, et al., 1947). Food under the warm fluorescent light could have been chosen the most because people prefer warmth in illumination (Birren, 1963).

Participants in the research conducted by Borsenik (1965) preferred green beans and mashed potatoes under the warm fluorescent light. A green matt pastel color became slightly duller and yellowed when placed under a warm white fluorescent light source (Wilson, 1960). Helson et al. (1956) also found a green color sample to become more yellowed when placed under a warm fluorescent source.

A cool fluorescent source accentuates the color green (General Electric, 1970; Allen, 1971; Buck, et al., 1947). Yet, three-fifths of the students in this research chose the green beans under the warm fluorescent source. The green beans under the warm fluorescence were characterized by a duller yellowish-green hue which is more typical of green beans cooked in the Southeastern United States.

II. ANALYSIS OF DATA

The null hypothesis was tested by the use of a chi square analysis. The results were recorded in Table 3.

Table 3. Chi Square Analysis of Food Choices Under Cool and Warm Fluorescent Lights

Food	Chi Square Values
Roast Beef	109.76*
Hamburgers	12.80*
Mixed Vegetables	3.22
Mashed Potatoes	67.24*
Green Beans	22.83*

*Significant at 5% level.

Preferences for both roast beef and hamburgers were found to have a significant difference in values at the 5% level. At the 5% level, preferences for mashed potatoes and green beans were significant but mixed vegetables were not. Therefore, it was indicated that all foods except mixed vegetables appeared different in the cool and warm lights implying that lighting was important in the acceptability of these foods.

III. PARTICIPATION

The college students were fairly cooperative in participating in the experiments. The students usually hesitated when first asked to make a choice between two pans of the same food. Most made a selection after the purpose of the experiment was explained. If a student would absolutely not make a decision, an answer was not forced. On eleven occasions individuals refused to make a selection. Over half of these abstentions were made by one male student.

IV. STUDENT REACTION

Even though comments on the food under the two light sources were not requested, students often volunteered their opinions. These comments were recorded.

Student reaction to the roast beef under the cool fluorescent light was all negative. Many felt the roast acquired a greenish cast. Other students observed a grayish color to the meat which caused it to look spoiled. One other individual thought the roast beef appeared artificial under the cool fluorescent light.

Complimentary remarks were made about the roast beef under the warm fluorescent light. However, when the meat was not well done, many felt it looked too rare. The warm fluorescent light seemed to strengthen the red color more than the brown color in this instance.

The same general comments made toward the roast beef under both lights were again suggested for the hamburgers. Students refused hamburgers under the cool fluorescent light because of the green hue.

The students had few verbal comments about the two lighted pans of mixed vegetables. The mixed vegetables lighted by the warm fluorescent source looked more yellow to some. Under the cool fluorescent light, the green vegetables had a nice green color and the corn also possessed a light green hue. Again someone mentioned the food had a plastic, artificial appearance under the cool fluorescent light.

There were several complimentary remarks for the green beans lighted by the cool fluorescent source. One student remarked the green beans appeared greener because a whiter light source was highlighting it. Many individuals said the green beans had a natural green color to them. Several students thought the beans were raw because they were so green. The warm fluorescent light seemed brighter to numerous students but the two tubes had the same wattage. Other opinions of the green beans lighted by the warm fluorescent light seemed to reflect background and geographical customs. Several chose the warm lighted green beans because that was what they were used to seeing at home. Numerous students said the green beans looked like typical Southern-style cooked beans. Others felt the beans appeared well done and that was how they liked them.

Various students thought the warm fluorescent light seemed brighter than the cool fluorescent light when directed over the mashed potatoes. Numerous comments were received about the potatoes being more yellow or buttery under the warm fluorescent light. One individual felt the warm light made the instant mashed potatoes look like real potatoes. Reactions to the cool fluorescent lighted mashed potatoes were mixed. Many said the potatoes had a greenish hue. Some selected the cool fluorescent lighted potatoes because of their pure white "color." Others refused to choose these potatoes due to their looking too white.

V. CONCLUSIONS

A significant difference was found between the warm and cool fluorescent lights on four-fifths of the selected food items. There was a particularly strong preference for the warm fluorescent light on the meat items. Numerous negative comments were made by the students about the cool fluorescent light on all food items.

The results of this research were in agreement with evidence previously found by other researchers. Several restaurants highlighted their roast beef with a warm fluorescent light because the cool fluorescent light source was found to degrade the appearance of the meat (Francis, 1970). A warm fluorescent light was chosen over a cool fluorescent source when green peas and mashed potatoes were judged (Borsenik, 1965).

Borsenik (1965) reported some results that were contradictory to the results in this study. Judges in Borsenik's experiments preferred roast beef lighted by a cool fluorescent tube. The students in this study chose the roast beef under the warm fluorescent light most frequently. The difference can possibly be explained by the fact that individuals do not "feel" the same about colors (Birren, 1963).

A panelist of men and women had strong preferences about five food items lighted by a warm and cool fluorescent light source (Helson, et al., 1970). Both sexes rejected the warm fluorescent light. The women preferred butter, raw beef, and an apple under the cool fluorescent tube. Francis (1970) tested the same food items and obtained similar results as Helson.

From the results of other researchers and this study, it can be concluded that an object does look different when observed under a warm fluorescent light as compared to a cool fluorescent tube. The results of this study suggest that food services would profit by high-lighting their meats with a warm fluorescent light. On the average, most vegetables would also appear appetizing under this light source. The color of the food really determines the type of fluorescent light one should use. While a warm fluorescent light emphasizes warm object tones, a cool fluorescent tube brings out the cool tones (General Electric, 1970; Allen, 1971; Buck, et al., 1947).

There are many possibilities of future studies in the area of lighting for the food service industry. A food service could conduct a test on the majority of their foods under both types of light. Whichever light received the most preferences should be installed in the serving and dining areas. A study using more foods and types of light would be interesting. A combination study of the type of light and the color of surrounding areas (walls, tableclothes, and other accessories) affecting food acceptability could be beneficial.

CHAPTER V

SUMMARY

Observations of food choices under warm and cool fluorescent lights on a cafeteria hot food line in a college food service were recorded as an indication of the effect of lighting on food acceptability. Roast beef, hamburgers, mixed vegetables, mashed potatoes, and green beans were used as typical foods served to college students dining in Presidential Court Food Service at The University of Tennessee Knoxville.

Of the five food items tested, those held under the warm fluorescent light source were chosen more often than foods held under the cool fluorescent source. The warm fluorescent light was highly preferred for all meat items. The differences in choices of roast beef, hamburgers, mashed potatoes, and green beans were significant at the 5% level. No significant difference was found for mixed vegetables lighted by a warm fluorescent light or a cool fluorescent light.

Most student comments concerning the cool fluorescent lighting on all five food items were negative. Numerous individuals felt the food had a greenish cast under the cool fluorescent light. Some thought items under cool fluorescence had an artificial appearance. A few students did have complimentary remarks for the green beans lighted by the cool fluorescent tube. The warm fluorescent light received complimentary remarks from the students on all five foods.

The results of this study supported evidence by others that a food item does look different when viewed under the two types of fluorescent lights. As can be seen from this study, a food service could promote increased sales by highlighting their food with warm fluorescent lights.

LIST OF REFERENCES

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Allen, C. J. 1971. Which white fluorescent lamp is right for you? Lighting Design and Application. 1(1): 38-45.

Billmeyer, F. W., Jr. and Saltzman, M. 1966. "Principles of Color Technology." Interscience Publishers, New York.

Birren, F. 1969. "Light, Color and Environment." Van Nostrand Reinhold Company, New York.

Birren, F. 1963. Color and human appetite. Food Technol. 17(5): 45-47.

Birren, F. 1961. "Color Psychology and Color Therapy." University Books, Inc., New Hyde Park, New York.

Borsenik, F. D. 1965. Artificial light and food. Cornell Hotel and Rest. Admin. Quart. 6(3): 72-74.

Buck, G. B., II and Thayer, R. N. 1947. Color technology of fluorescent lamps. Illum. Eng. 42(4): 415-434.

Campbell-Smith, G. 1970. Marketing the meal experience. Cornell Hotel and Rest. Admin. Quart. 11(1): 73-102.

Clydesdale, F. M. and Francis, F. J. 1971. Color measurement of foods: XXVII The chemistry of meat color. Food Product Development. 5(4): 81-90.

Clydesdale, F. M., Fleischman, D. L., and Francis, F. J. 1970. Maintenance of color in processed green vegetables. Food Product Development. 4(5): 127-138.

Evans, R. M. 1965. "An Introduction to Color." John Wiley and Sons, Inc., New York.

Francis, F. J. 1970. Effect of color on food acceptability. IN Proceedings SOS/70. Third International Congress Food Science and Technology. Washington, D. C. 415-420.

General Electric Company, Large Lamp Department. 1973. "Fluorescent Lamps." TP-111. Cleveland, Ohio.

General Electric Company, Large Lamp Department. 1970. "Store Lighting." TP-106. Cleveland, Ohio.

General Electric Company, Large Lamp Department. 1968. "Light and Color." TP-119. Cleveland, Ohio.

Guilford, J. P. 1934. The affective value of color as a function of hue, tint, and chroma. J. Exp. Psychol. 17: 342-370.

Helson, H. and Lansford, T. 1970. The role of spectral energy of source and background color in the pleasantness of object colors. Applied Optics. 9(7): 1513-1562.

Helson, H., Judd, D. B., and Wilson, M. 1956. Color rendition with fluorescent sources of illumination. Illum. Eng. 51: 329-346.

Hill, D. 1969. Favorite colors--a report. Color Eng. 7(6): 46-50.

Jacobson, E. 1948. "Basic Color." Paul Theobald, New York.

Judd, D. B. 1952. "Color in Business, Science, and Industry." John Wiley and Sons, Inc., New York.

Nickerson, D. 1960. Light sources and color rendering. J. Opt. Soc. Am. 50: 57-69.

Suarez-Solis, D. 1965. Color and human vision. Cornell Hotel and Rest. Admin. Quart. 6(3): 69.

Wilson, R. F. 1960. "Colour in Industry Today." George Allen and Unwin, LTD, London.

Wright, W. D. 1969. "The Measurement of Colour." Van Nostrand Reinhold Company, New York.

APPENDIX

Date ______________________________

Name of Food ______________________

Total Number of
Observations Tested ______________

FREQUENCY OF CHOICES (ENTREES AND VEGETABLES)*

Choices Under Warm Fluorescent Light												Choices Under Cool Fluorescent Light											

Total __________   Total __________

*By continuous recording of each type of food served.

Number making no selection:

COMMENTS:

VITA

Janice Ward Pafford, wife of Don Pafford, was born in Humboldt, Tennessee, on June 23, 1951. She attended Trenton and Dyer Elementary Schools and was graduated from Dyer High School as valedictorian in 1969. In June she entered the College of Home Economics at The University of Tennessee, Martin. The following June she transferred to The University of Tennessee, Knoxville. She received a Bachelor of Science degree with a major in Institution Administration with high honors in August, 1972.

In the Fall of 1972, she received an Allied Health Traineeship for graduate study in the Department of Food Science and Institution Administration. She will complete requirements for a Master of Science degree with a major in Institution Administration in August, 1973. She is a member of Omicron Nu and Phi Kappa Phi Honorary Societies.

The author is the daughter of Mr. and Mrs. Wallace Ward of Trenton, Tennessee.