EFFECTS OF EXPECTANCY, FOOD PREFERENCE AND TIME OF DAY ON SALIVATION IN CANCER PATIENTS

by

Alice G. Friedman

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APPROVED:

J.J. Franchina, Chairman

C.G. Baum

R.E. Eisler

G.A. Clum

J.J. Lanter

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(Abstract)

The purpose of the present study was to study differences between cancer patients and noncancer patients in taste acuity and in salivation to food and stimuli associated with food. Subjects were twenty male cancer patients and eighteen patients hospitalized for noncancer-related illnesses. All cancer patients were tested prior to chemotherapy or radiation therapy.

The study was conducted on two consecutive days. On Day 1 taste acuity was measured to bitter, sweet, sour and salty flavors using the forced choice three-stimulus drop technique on concentration from 6-2000 mm/l. Subjects completed a questionnaire on appetite difficulties, the Multiple Adjective Affect Check List (MAACL), and rated a list of snacks on a 5-point scale. On Day 2 salivary responding (using the Strongin-Hinsie Peck Test) was measured after subjects were told to expect food, after the presentation of food and after ingestion. For each subject, testing occurred in the morning and in the afternoon to high and low preferred foods.

Cancer patients were significantly more likely than noncancer patients to report appetite difficulties which included premature satiety, decreased appetite, and changes in food preference. Cancer and noncancer patients did not differ reliably on the MAACL or in taste

acuity. In salivation testing, the presentation of food increased salivation in noncancer patients but decreased salivation in cancer patients. However, the differences between cancer and noncancer patients was not reliable. The interaction between illness condition and test trials during the presentation of food did approach significance.

The lack of reliable effects for illness condition may have occurred because the interval of food deprivation was too short to elicit reliable increases in salivation and external and social cues which normally accompany mealtime were not present during testing.

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INTRODUCTION

Appetite Difficulties in Cancer Patients

Many cancer patients exhibit loss of appetite, aversions to specific foods, premature satiety, and/or alterations in taste sensitivity. Diminished appetite may precede the diagnosis of cancer and may be the initial symptom which alerts the patient to seek medical attention (Theologides, 1976). The consequences of these symptoms may be decreased food intake and subsequent weight loss. Diminished food intake may have a deleterious effect on the patient's nutritional status, response to treatment and probability of recovery from the disease (Shils, 1979). In fact, weight loss may be a better predictor of morbidity than is tumor stage, histologic type, performance index, or type of chemotherapy (Costa & Donaldson, 1974). Autopsy reports from 500 cancer patients have revealed that more than 22% had died without identifiable cause other than cachexia. Cachexia is defined as decreased food intake, hormonal aberrations and general wasting of body tissue (Donaldson, 1979). In an unpublished survey of 222 hospitalized cancer patients at various stages of cancer and treatment, approximately 45% of the patients had lost more than 10% of their preillness weight while 25% had lost more than 20% of their body weight (Corbin & Shils, as reported in Shils, 1979).

The cause(s) of cachexia are poorly understood. However, a number of subjective symptoms which are related to eating behavior are widely recognized. For example, several studies (Carson & Gormican, 1973;

DeWys & Walters, 1975) have indicated that cancer patients report changes in taste sensitivity and/or in the palatability of many common foods. As many as half of all cancer patients report a reduction of pleasure associated with the taste of food (DeWys & Walters, 1975). Cancer patients rate meats, vegetables and fruits as less pleasurable than do healthy controls (Quinn, Settle, Brand, Dare & Mullen, 1978). Many cancer patients develop aversions to foods which they formerly enjoyed such as, meat, coffee, sweets and chocolate (Dewys, 1975). According to Vickers, Nielson and Theologides (1981), 43% of cancer patients reported that at least two specific foods or groups of foods had become unpleasant since the patients were diagnosed as having cancer. High protein foods, cereal products, and sweets were reported as being less palatable for these patients than for patients who did not experience food aversions. Further, Quinn et al., (1978) reported that on a preference questionnaire cancer patients rated several foods as being more pleasurable than did healthy controls on a preference questionnaire. But when the food was physically presented at mealtimes, cancer patients rated the food as less pleasurable than did controls. Thus, cancer patients and healthy individuals may anticipate food similarly but cancer patients may react differently to the presentation of food.

Regulation of Food Intake

In normal subjects, the regulation of food is mediated by numerous factors including peripheral factors, such as, taste, smell and stomach

distention, and metabolic processes such as those regulated by the hypothalamus. "Metabolic processes influence, coordinate and integrate peripheral factors with neural elements" (Sullivan & Cheng, p 22, 1978) to control food intake. In a normal environment, organisms maintain optimal body weight by appropriate regulation of caloric intake. Gustatory and sensory elements are important to both the selection of food and the control of eating. Snowdon (1969) showed that the eating response is attenuated by the absence of oropharyngeal stimuli. Rats which were trained to bar press for food delivered intragastrically showed a decrease in motivation to eat. For human subjects aberrations in taste perception not only diminish the enjoyment derived from eating but can modify food choices and dietary habits (Carson & Gormican, 1977). For patients with compromised health status, changes in taste acuity may result in decreased food intake, exacerbation of the disease and further nutritional deficiencies. Because taste stimulates salivary and pancreatic flow, aberrations in taste sensitivity may alter digestion (Schiffman, 1983).

Taste

Taste is mediated through approximately 10,000 taste buds located on the tongue, palate, pharynis, larynis, epiglottis and upper third of the esophagus. Most of these receptor organs reside on and around small protuberances of the tongue called papillae. There are four types of papillae, three of which contain taste buds: fungiform, circumvallate, palatal, and filiform. The taste buds on the

circumvallate form a V-shaped grove over the posterior third of the tongue and are innervated at the ninth nerve. Fungiform papillae cover the anterior two thirds of the tongue and are innervated by the seventh cranial nerve. Palatal receptors are located on the folds or clefts of the lateral border of the tongue, anterior to the circumvallate. Taste impulses pass from the seventh, ninth and tenth nerve to the medulla, pons, thalmus and corical taste areas (Henkin, 1976).

Different areas of the tongue appear to be sensitive to different tastes. The rear portion of the dorsal surface is more sensitive to sour. The tip of the tongue is most sensitive to salty and sweet stimuli. Although each taste bud appears to respond to all four taste stimuli (bitter, sweet, sour, and salty), they respond differently to each stimulus. There are several theories about the specific mechanisms responsible for the differential responding of the taste buds. The most widely accepted theory proposes that the nervous system is capable of detecting the ratio of stimulation of each type of taste bud. The ratio of stimulation across task receptors will determine what taste is perceived (Guyton, 1977). Taste receptors have a life span of 10-10 1/2 days, and undergo continuous renewal. An interruption of mitosis by disease, stress, age, drugs or malnutrition will alter taste sensitivity (Schiffman, 1983).

Taste in Cancer Patients

There is evidence that cancer patients exhibit alterations of responding to the four primary taste modalities; sweet, sour, bitter

and salty (Dewys & Walter, 1975; Gorshein, 1977; Williams & Cohen, 1978). Comparisons between cancer patients and normal healthy controls on the detection and recognition thresholds of the four primary taste stimuli showed that cancer patients exhibit increased recognition thresholds for salt (Carson & Gormican, 1973; Abasov & Henkin, 1961), sweets (DeWys & Walters, 1975), and sour (Williams & Cohen, 1978) and lower thresholds to bitter (DeWys & Walters, 1975). These data on altered taste acuity in cancer patients seems consistent with the patients' reports of altered food selection/preference. For example, decreased thresholds to bitter appears to be correlated with meat aversions (DeWys & Walters, 1975). Increased thresholds to sweet appears to be correlated with patients' reports of a general decrease in pleasure derived from food (Carson & Gormican, 1975; DeWys & Walters, 1975).

Salivary Secretion

Although changes in taste acuity may importantly change eating behavior in cancer patients, another critical factor which may be implicated is salivary secretion during the process of ingestion. In normal subjects, salivary responding is an integral part of appetite (Sahakian, 1981). Salivation, a cephalic reflex, generally precedes ingestion of food and serves several functions. Initially saliva mixes with dry food and serves as a lubricating agent. Saliva alters the concentration of food particles. Taste receptors are stimulated when saliva dissolves food molecules. Additionally, saliva contains an

enzyme (ptyalin) which initiates the conversion of starch into sugar (Shwartz, 1982) and influences digestion.

Saliva contains two types of secretions; serous secretion and mucous secretion. The serous secretion contains ptyalin which initiates digestion. The mucous secretion serves as a lubricating agent. The sublingual and small buccal glands secrete only mucus secretion, while the parotid glands secrete only serous secretion; the submaxillary glands secrete both serous and mucous secretions. Nerve impulses from the superior portions of the salivatory nuclei control the submaxillary and sublingual glands. Inferior portions of these nuclei control the parotid gland. In normal ingestion, the medulla and pons are stimulated via the salivatory nuclei. Saliva can also be stimulated by impulses traveling from higher centers of the central nervous system to the salivatory nuclei. (Guyton, 1977).

Salivation Behavior

Despite the pervasive influence of Pavlov's initial salivary conditioning studies, salivary responding has received relatively little attention in behavioral research as compared to other autonomic indices. The dearth of research may be due to the apparent inconsistency of the response (White, 1975). Early researchers (Pavlov, 1910) found that the presence and magnitude of salivary flow varies depending upon a wide range of uncontrolled variables. According to Pavlov, the response is characterized by a "considerable degree of fickleness and inconstancy" (Pavlov, 1910, p. 84).

Consequently, studies of human salivation have been sporadic (White, 1975), and the relationship between salivary flow and eating remains poorly understood.

In recent years, the increased concern about health, dieting and eating disorders has been accompanied by a resurgence of interest in the salivary response as a measure of appetite. This work has been facilitated by the availability of fairly precise methods of measuring salivary flow, and early findings (see White, 1975; Wooley & Wooley, 1973) that salivation may be a sensitive indicator of appetite (Sahakian, 1981).

Measurement

A variety of techniques for collecting and measuring salivary flow are available. Cannulization, used in Pavlov's early studies, was developed for use with animals. A small opening is made in the check of the animal. The parotid gland is directed outward to the organism's cheek and salivary flow is caught in tubes which measure drops of saliva. Other traditional methods include insertion of cannulae directly into Stenson's duct (Ordenstein, 1860), or Wharton's duct (Clark & Carter, 1927), measuring increased weight of dry food after it has been chewed (Tuczek, 1876) and recording the number of swallows (Krasnogorsky, 1931). These methods proved to be both unreliable and/or unsuitable for human research, and have since been replaced by more practical and reliable methods.

The Strongin-Hinsie and Peck (SHP) technique (Poth, 1933) is the most commonly employed method of measurement. The SHP is currently relatively inexpensive, reliable and easy to administer. Three absorbant 1 1/2 inch cotton dental rolls are inserted in the mouth, two bilaterally and one sublingually. An alternate method uses one dental roll placed sublingually (Farley & Osborn, 1969). The rolls remain in the mouth for a specified length of time, usually two minutes. The difference between pre and post insertion weights serve as the dependent measure. Reliabilities for the SHP are high, ranging from .83 for test-retest reliability over a one year interval (Gottliev & Paulson, 1961) to .86 over a 24 hour interval (Palamai & Blackwell, 1965).

Rate of Salivary Secretion

The salivary glands secrete saliva continously even in the absence of obvious stimuli (Jenkins, 1978). Spontaneous salivary flow rates are highly reliable across time. In a test-retest study of the spontaneous salivary rates for 40 subjects, Becks (1939) found that flow rates were highly consistent over a two year period. However, salivary flow is influenced by circadian rhythms (Jenkins, 1978). Normal individuals exhibit diurnal patterns of salivary flow, with maximal secretion in the morning decreasing gradually to a minimal flow in the late evening (Palmai & Blackwell, 1965).

Appetite

Researchers have demonstrated that in a variety of animal species food intake is a function of conditions such as length of deprivation, perloads of food, palatability and familiarity of food and nutrient and caloric density (Jordan, Wieland, Zebley, Stellar, & Stunkard, 1966). These researchers have relied primarily on food intake as an ojbective measure of appetite with varying degrees of success. In humans appetite seems to be influenced by cognitive, behavioral and physicological events. The "complex and ubiquitous: (Nirenberg & Miller, 1982) nature of appetite, or the desire to eat in humans, has made an objective measure of appetite difficult to arrive at. Hunger ratings, and amount of food tintake, which are frequently used indices of appetite are subject to the biasing effects of response set, the appearance of and information about the food and attitudes towards food (Siegel & Hagen, 1982).

Salivation behavior has recently been offered as an objective measure of appetite, which is less susceptible to these biasing effects (Booth & Fuller, 1981). Salivation is affected by conditions such as caloric intake, length of deprivation, rate of food consumption and appetitie suppressants which are known to be related to appetite and food intake in humans. Further, salivation may be less affected by the effects of response set, and experimental demand then are hunger ratings, amount of food eaten and ratings of food appeal (Wooley & Wooley, 1973). Therefore, salivation appears to be an objective measure which correlates positively with other indices of appetite

(Wooley & Wooley, 1973). The following is a discussion of the variables affecting salivary flow.

Variables Affecting Saliva Flow

In normal ingestion, the salivary response is elicited by situations which are typically associated with eating behavior. For example, increased parotid saliva flow has been elicited from subjects' looking at food (Hagashi & Ararie, 1963), thinking about food (Jenkins & Dawes, 1978), expecting to eat food (Wooley & Wooley, 1973), and ingesting food (Hodgson & Greene, 1980). Salivary flow is positively correlated with hours of deprivation prior to food exposure and with subjects' ratings of intensity of hunger (Wooley & Wooley, 1973). In healthy subjects, ingestion of a small amount of food elicits an increase in salivation. This effect, known as priming, increased as food deprivation increased from one half hour to four hours (Hodgson & Greene, 1980).

Food Deprivation

Length of food deprivation is positively correlated with rate of salivary flow in the presence of palatable food. Finch (1938) demonstrated elevated rates of unconditioned and conditioned salivary flow in canines as length of deprivation increased from 0 to 7 hours. Zenar and McCurdy (1939) showed a similar increase in salivation as length of deprivation increased from satiety to 21-24 hours.

James, Peacock and Rollins (1960) showed salivary responding is sensitive to conditions of deprivation and satiety. They observed an attenuation of the salivary response to an established food CS following injection of food directly into the stomach and following the actual consumption of food. They also found that inhibition of the salivary response preceded the cessation of the motor responses related to eating. James et al, (1960) interpret these findings as evidence indicating that the salivary response to an established CS may be a more sensitive indice of "hunger drive" than is the actual response of eating (Wooley & Wooley, 1981).

The positive correlation between hunger and salivary flow in the presence of food has been demonstrated in humans by manipulating 1) length of food deprivation, 2) amphetamine-induced anorexia, and 3) caloric preloading. The most frequent finding is that salivary flow is a direct function of length of food deprivation (Wooley & Wooley, 1981). Wooley and Wooley (1972) demonstrated that subjects exhibited an elevated rate of salivary flow to the presentation of dessert when the dessert is presented before, rather than after, a meal. Similarly, the rate of salivary flow is lower to food presented at 12:00 then if lunch is withheld and food is presented at 2:00 pm. Wooley and Dunham (1976) demonstrated that normal weight subjects exhibited an elevated rate of salivary flow to palatable food if the food was presented after the subjects' normal eating time.

Amphetamine is a central nervous system stimulant which suppresses appetite. Wishart and Walls (1974) found that rats consume less food after injections of d-amphetamine. Amphetamines also have an anorectic

effect in humans (Wooley & Wooley, 1981). If salivary flow is a measure of appetite, amphetamine should also suppress salivation. Salivary flow is attenuated by 10 mg of amphetamine ingested an hour prior to food presentation (Wooley, Wooley, & Williams, 1976).

Caloric preloading is accomplished with oral ingestion of a liquid food substance with varying nutritional and caloric values. The subject is generally unaware of the consistency of the drink (Wooley & Wooley, 1981). Following a period of food deprivation, the liquid is ingested and saliva is collected in the presence of food. Using this method, salivary flow has been found to be inversely related to caloric preload (Durrant & Royston, 1979) and percentage of protein (Wooley, Wooley, & Williams, 1978). Wooley, Wooley and Kay (in Wooley & Wooley, 1981) demonstrated that preloading of fats have a greater suppressive effect on salivary responding to a palatable food (pizza) than do isocaloric and isovolumetric preloads of protein and carbohydrates. The differential responding persists for four hours.

Expectancy, Cognition, & Inhibition

A minimal degree of hunger is a prerequisite for eliciting the salivary response. However salivary flow is often inhibited even in the presence of hunger. Stress (Bates & Adams, 1968), depression (Peck, 1958), and fear (Bogdonoff & Wolfe, 1961) are associated with suppressed rates of salivary flow. Verbal instruction and feedback can also alter salivary flow. In one study (Well, Feather & Headrick, 1973), subjects who were given instructions to decrease their salivary

rates, along with immediate auditory feedback, were successful in inhibiting salivary flow. Siegel & Hagen (1982) obtained similar results with the use of instructions alone. In another study, Wooley, Wooley and Dunham (1976) demonstrated suppressed rates of salivary flow in the presence of palatable food (pizza) in subjects instructed that they would not be allowed to eat the food for two hours, compared to subjects who were told they could eat immediately.

Instruction can also have an excitatory affect on salivary flow. Food words elicit significantly greater rates of salivation than do nonfood words (Staats & Hammond, 1972). In a study (White, 1976) of the influence of instruction on salivary flow, subjects who were most successful at increasing their salivary rate according to instructions did so by imagining food related stimuli, rather than by concentrating on salivation. As noted above, the thought of palatable food serves an excitatory function as does the actual sight of food (Wooley & Wooley, 1973).

Aberrations of Salivary Function

Aberrations in salivation gland responding are associated with decreased food intake and body weight (Bixler, 1957), increased prevalence of oral bacteria, and increased incidence of dental carries (Weisberger, 1940). Most investigations of the effect of aberrations in salivary functioning have been conducted with animals (Jenkins, 1970). However, the inactivity of salivary glands in man, a condition known as "aptyalism" or "xerostomia", results in difficulty swallowing and talking, halitosis and increased dental caries (Jenkins, 1978).

Relationship Between Salivary Responding and Cancer

Salivary dysfunction (dry mouth) may interfere with the ingestion of food and thereby may contribute to reports of appetite difficulties in cancer patients. Few studies have examined the relationship between appetite difficulties and salivary responding in cancer patients. DeWys (1979) has suggested that aberrations in salivary flow in cancer patients may alter appetite, taste acuity, and digestion. Two studies (Chencharick & Mossman, 1983; Mossman, Shatzman & Chencharick, 1982) have documented aberrations of salivary responding among cancer patients receiving radiotherapy. Chencharick & Mossman (1983) interviewed seventy-four patients with head and neck cancer and found increases in reports of dry mouth and an increase in fluid intake in 25% of these patients prior to radiotherapy. Fourteen percent of their sample reported changes in taste; twenty percent reported appetite loss.

Impairment of salivary function is a frequent complication of radiotherapy to the head and neck. However, Chencharick & Mossman (1983) found reports of impairment prior to treatment. The specific mechanisms responsible for aberrations in salivary responding remain unclear. They may be due to actual tissue damage, obstruction and/or metabolic changes secondary to cancer.

One purpose of the present study was to examine whether there are differences between cancer patients and noncancer patients in salivation responding to food and to stimuli associated with eating. Exposure to food and thinking about food typically elicits increases in

salivation in normal individuals (Hodgson & Greene, 1980). Salivary flow is typically greater to the presentation of food than to the thought of food and greater still following ingestion of a small amount of food (Hodgson & Greene, 1980). Currently there is no information about the influence of these factors on salivation in cancer patients.

Cancer patients often report feeling hungry prior to starting to eat a meal, but report feeling full after a few bites. And they frequently complain about having difficulty eating later in the day. It is possible that cancer patients exhibit normal salivary flow when they think about food, but they may differ from normals in salivary responding to the presentation of food and after ingestion (Quinn et al, 1978).

On the other hand, altered salivary flow may also be related to cancer patients' changes in taste acuity: namely, their reports of greater sensitivity to bitter and sour taste and decreased sensitivity to sweets. Insufficient salivation may result in an inhibition of stimulation of the taste receptors, thereby altering the usual taste of food (DeWys, 1979). Further, if changes in their eating pattern relates to time of day it is important to evaluate salivation at different temperal periods in a day.

To investigate these possibilities the present experiment measured salivary responding and taste acuity in cancer patients and noncancer patients over two days. On Day 1 taste acuity was assessed to the four primary tastes (bitter, sweet, sour and salty). On Day 2 salivary responding was measured in morning and afternoon sessions. During each session, salivation was measured after subjects were told to expect

food, after the presentation of food and after ingestion. Since food preference may importantly affect salivation, salivation was measured in relation to a most and least preferred snack.

HYPOTHESES

1. More cancer patients than noncancer patients will report appetite difficulties.
2. Cancer patients will show increased taste thresholds to sweet and decreased taste thresholds to bitter, relative to that for noncancer patients.
3. Salivation will be greater to highly preferred foods than to least preferred foods for cancer and noncancer patients.
4. Salivation should be greater in the expectancy condition then in the nonexpectancy condition for cancer and noncancer patients.
5. Presentation and ingestion of food should increase salivation above baseline amounts in cancer and noncancer patients.
6. Cancer patients should differ from noncancer patients in salivation during the expectation, presentation, and ingestion of food.

METHOD

Subjects

Subjects were twenty male volunteer cancer patients at the Veterans Administration Medical Center, Salem, Virginia. The group consisted of patients with a diagnosis of carcinoma with the primary in the lung (14), prostate (3), bone (1) and vocal cords (1). One subject had metastatic lymphoma. The patients ranged in age from 43 to 88 years (mean = 65.8 years). The extent of the disease varied from early metastases involving one organ system to more extensive involvement. For all subjects there was a histologic confirmation of the primary cancer site obtained from the patient's chart and the attending physician. None of the subjects had received radiation or chemotherapy.

Twenty patients who were hospitalized for noncancer-related disorders were recruited to serve as a comparison group. Two control subjects who were suspected of having a history of alcoholism were eliminated from the study. Noncancer patients ranged in age from 42 to 71 years (mean = 59.2 years), and were hospitalized for illnesses (see Appendix A) which would not be expected to cause aberrations of taste or/and salivary responding. Cancer and noncancer patients did not differ significantly in age or smoking history.

Subjects were screened for the study by their attending physicians. Only individuals who met the following criteria were included: (a) those with no diet restrictions other than texture,

(b) no chronic alcoholism, and, (c) those who received no medications (Appendix B) or had a medical disorder known to affect taste acuity or salivary flow. All patients were tested at least one day after admission to the hospital and prior to cancer treatment.

After being referred to the study by their attending physician, potential subjects were asked to participate in a project on taste acuity and salivation (Appendix C). Participating subjects were asked to complete an information form (Appendix D), which was read to them. Subjects were given a consent form (Appendix E) to read and sign, and a copy to keep. Subjects were told that the testing would be conducted on two consecutive days. Arrangements were made for the first measurement session.

Experimenters

Seven upper level undergraduate psychology majors who had previous research experience and one graduate student in clinical psychology served as experimenters. Prior to data collection, each experimenter attended four sessions of training. Training consisted of demonstration and instruction in the test procedures. Afterwards the experimenters practiced administering the test procedures to each other. Experimenters attended weekly meetings throughout data collection to discuss procedures, subject recruitment, scheduling and the progress of the study.

Design

Subjects were randomly assigned to groups in a 2 (Illness Condition) by 2 (Expectancy) by 2 (Time of Day) by 2 (Preference) repeated measures design. Specifically, there were two illness groups: cancer patients and noncancer patients; two conditions of expectancy: expectancy and no expectancy; two measurement times: morning and afternoon; and two levels of preference: high and low. Illness and expectancy were between-groups manipulations; time of day and preference were within-subjects manipulations.

For all subjects the study was conducted on 2 consecutive days. Taste acuity was measured on Day 1; salivation responding on Day 2. Testing was conducted at a table and chair next to the patient's hospital bed. Any stimuli obviously related to food and/or ingestion were removed from sight.

On Day 1 taste acuity was measured for each subject at approximately 11:00 am. All subjects were given a standard set of instructions (Appendix F), followed immediately after by the taste acuity test. Following testing, each subject received a list of frequently-encountered snacks (Appendix G) and was asked to rate the snacks according to degree of preference from highly preferred (1) to not preferred (5). If more than one snack was rated as "1" or "5" the subject was asked to choose the one on the most extreme end of the scale. Likewise, if no item was given a "1" or "5". After completing this task, each subject was asked to complete the Multiple Affect

Adjective Checklist (MAACL; Zuckerman & Lubin, 1965) (Appendix H). Upon completion of the MAACL, subjects were thanked for their participation in the study so far and were reminded of the test session the following morning.

At the start of Day 2 subjects were reminded of the rationale for the study and the procedure of the day was explained to them. Each subject received 2 adaptation and 8 test trials in each of two test sessions, morning and afternoon. During each block of 8 test trials, four trials recorded salivation to a highly preferred snack; four trials recorded salivation to a less preferred snack. All subjects received a snack item rated as highly preferred (1) and low least preferred (5). An example of a highly preferred snack was potato chips; an example of a least preferred snack was crackers. Order of snack presentation was counterbalanced within subjects across morning and afternoon sessions and across groups.

For each set of 4 test trials, a two minute adaptation trial preceded the first test trial. During the adaptation, subjects were asked to sit, relax and, if they chose, to read available nonfood related material (eg. magazines). Subjects were told:

> We are interested in examining how cancer may affect salivation and how factors such as time of day may be involved. To do this, we will need to measure your salivation a number of times. We will be asking you to put dental rolls in your mouth for brief periods of time.

Instructions for the salivary measure (Appendix I) were read to the subjects.

After a two minute adaptation period, all subjects were told to insert new dental rolls for the baseline measure (test trial 1). They were reminded about how to insert the dental rolls.

After test trial 1 (baseline), all subjects were told to insert new dental rolls for a second test trial. Specifically, they were told:

> It is time to take the next measure. Please put the dental rolls back in your mouth.

Following insertion of the dental rolls, subjects in the Expectancy condition (n = 19) were told:

> Yesterday you read a list of snacks. Remember ___snack name___ was on the list. I am going to give you a ___ snack name___ to eat. Think about how it will look and how it will taste. Remember, it was one of the snacks you said you really liked/disliked.

Subjects in the No expectancy condition (n = 19) were told:

> This is another salivary measure. Please keep the dental rolls in your mouth until I tell you to take them out. You are doing fine.

The instructions were repeated during the two minute test trial to keep the subject attending to the stimuli. After Trial 2, all subjects were told:

> I am going to get a ___snack name___ for you to eat. But before I do, let me set you up for another salivation measure. Please put these dental rolls in your mouth.

After the dental rolls were in place, the snack (e.g., a potato chip) was removed from a bag and placed on the table in front of the subject. The subjects were told:

> As soon as I'm finished with the measurement you can eat the ____snack name____.

After Trial 3 subjects were told:

> Go ahead and eat the snack.

Two minutes after the subject finished ingesting the snack the subject was told:

It is time for another measure. Please put these dental rolls in your mouth.

Following Trial 4, subjects were told to take a ten minute rest. After the break the procedure was continued.

After the second set of 1 adaptation trial and 4 test trials, subjects were reminded about the afternoon test session, to begin two hours after lunch. The procedure for the afternoon session was identical to that of the morning session except that the order of presentation of high and low preferred snacks was reversed from that of the morning session.

At the conclusion of the afternoon session, subjects were thanked for their participation in the study.

Dependent Measures

Measure of Taste Acuity

On Day 1 subjects were tested individually with the thirteen concentrations of each of four primary taste stimuli (sweet, salty, bitter, and sour). Detection and recognition thresholds for taste stimuli were measured in each subject by the "forced choice three-stimulus drop technique" developed by Henkin, Schechter, Hoye and Maltern (1971). One drop of solution and two drops of water were applied to the alternate sides of the anterior third of the tongue and

allowed to spread. Subjects rinsed their mouth with water prior to and following testing with each flavor group. Solutions were presented at room temperature.

Following each three-drop application, detection and recognition thresholds were measured. The lowest concentration of solution which the subject correctly distinguished as being different from water was recorded as the detection threshold. The lowest concentration of solution which the subject correctly identified was recorded as the recognition threshold. For each-three drop application the subject was asked to respond to three questions:

1) Were the three drops the same or was one different from the other two?
2) If there was a dissimilar drop, which drop 1, 2 or 3 was it? and
3) what was the characteristic taste of the dissimilar drop?

To eliminate error due to guessing, a correct response followed by an incorrect response was considered a guess. Testing was continued until three consecutive responses were obtained. The first correct response followed by two correct responses was considered the subject's detection/recognition threshold. After the subject correctly detected and identified a taste substance at three consecutive increasing concentrations of the flavor, the next flavor was administered. Order of presentation of taste stimuli was counterbalanced across subjects.

Concentrations of the primary taste stimuli were prepared by aliquot. For example, 684 grams of sucrose (2000 mm/l) was weighed on a Torsion Balance accurate to ten milligrams. This quantity was then

transferred to a 1000 ml graduated cylinder and water was added to make 1000 ml. The concentrated solution was transferred to a Brown plastic covered container which was labeled and refrigerated. From this container, aliquots of the desired concentration were measured and diluted. The same procedure was used in preparing sodium chloride (NaCl), hydrochloric acid (HCl) and urea aliquots. All solutions were presented in concentration of 2000, 1000, 800, 500, 300, 220, 150, 120, 90, 60, 30, 12, and 6 mm/l.

Measurement of Salivation

The procedure for measuring salivation was similar to that employed by Hodgson and Greene (1980), known as the Strongin-Hinsie Peck (SHP) Test. Sealable plastic bags containing three cotton rolls (Johnson and Johnson No. 3 1/2 dental rolls) were weighed (to the nearest 100 mgm) immediately prior to each test session. Subjects were instructed to remove the rolls from the bags and insert the rolls in their mouth, two bilaterally and one sublingually. Subjects were instructed not to move their mouth while the rolls were in place. The dental rolls remained in the subject's mouth for two minutes (measured by a stop watch). After two minutes the subjects were instructed to remove the dental rolls with tweezers or by dropping them from their mouth into the bag. The bag was weighed within a half hour of the end of the test session. The difference between pre and postplacement weights represented the amount of salivation for each two minute period.

Multiple Affect Adjective Checklist

The MAACL (Zuckerman & Lubin, 1965) is a paper and pencil self report inventory which consists of 61 alphabetically ordered adjectives. Subjects are instructed to marked an "X" next to the words which describe how they generally feel. The MAACL provides a measure of hostility, depression and anxiety. These three factors were empirically derived (Zuckerman, 1960) and have high internal reliability, ranging from .79 for Anxiety to .90 for Hostility (Zuckerman, Lubin, Vogel, & Valerius, 1964). The Anxiety factor correlates significantly with the STAI (Johnston & Hackmann, 1976), and observed anxiety in psychiatric patients (Zuckerman, et al., 1964). The Depression factor correlates significantly with the Inpatient Multidimension Psychiatric Depression Scale (Lorr, Klett, McNair & Laske, 1962) and the D scale of the MMPI (Zuckerman, 1965). There have been few valiation studies of the Hostility factor.

The MAACL is frequently used in studies of affect in a medical population (Francis, 1981; Kimball, Quinlan, Osborne & Woodward, 1973; Lyles, Burish, Krozely & Oldham, 1982). Unlike the Beck Depression Inventory, the MAACL does not contain somatic items. Therefore, it is unlikely that the results of the MAACL are confounded by symptoms of the medical condition.

RESULTS

Appetite Difficulties

Figure 1 shows percentage of cancer and control subjects who reported appetite difficulties. These difficulties consisted of premature satiety, decreased appetite, change in food preference and difficulty eating as a function of time of day. On each measure the percentage of cancer patients was greater than that of control patients. Chi square tests between cancer and noncancer patients (Table 1) yielded a significant effect of cancer on presence of appetite difficulties, premature satiety, decreased appetite and change in food preference. These data are consistent with previously reported appetite changes in cancer patients (DeWys, 1976).

Affect Ratings

Table 2 shows mean scores for cancer and noncancer patients on the anxiety, hostility and depression factors of the MAACL. Neither group showed significant elevations on the anxiety or hostility factors. One cancer patient obtained an elevated score on the depression factor (t = 71). An Analysis of Variance (ANOVA) for the MAACL (Table 3) yielded no reliable differences between the cancer and noncancer group . These data suggest that differences between the cancer and noncancer group on other measures are not likely to be attributable to differences in affect.

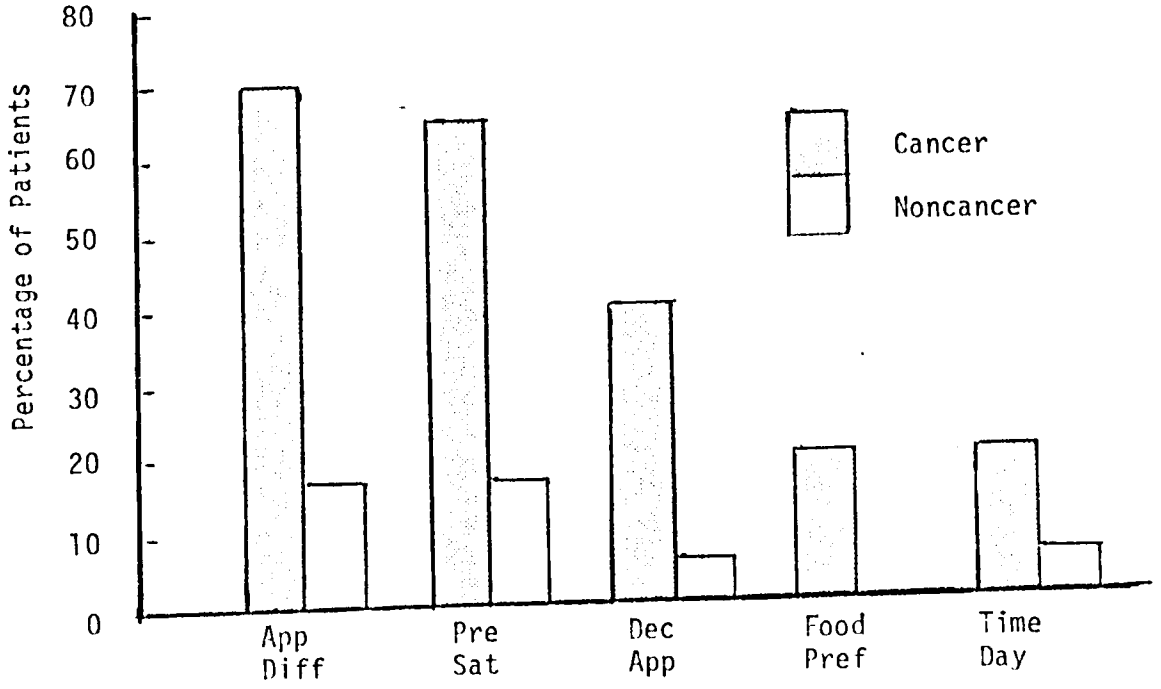

FIGURE 1

Percentage of Cancer and Noncancer Patients Who Reported Appetite Difficulties (App Diff): Premature Satiety (Pre Sat), Decreased Appetite (Dec App), Changed Food Preference (Food Pref) and Difficulty Eating As a Function of Time of Day (Time Day).

TABLE 1

Chi-Square for Percentage of Cancer and Noncancer Patients Who Reported Appetite Difficulties, Premature Satiety, Decreased Appetite, Changed Food Preferences and Difficulty Eating as a Function of Time of Day

Measure	df	X^2
Appetite Difficulties	1	10.90 ***
Premature Satiety	1	9.08 **
Decrease in Appetite	1	6.22 **
Change in Food Preference	1	4.02 *
Difficulty Eating as a Function of Time of Day	1	1.73

* $p < .05$ ** $p < .005$ *** $p < .001$

TABLE 2

Mean Scores For Anxiety, Hostility
and Depression Factors of the
MAACL for Cancer and Noncancer Patients

	Anxiety	Hostility	Depression
Cancer	4.07 (t=44)	3.59 (t=42)	14.86 (t=58)
Noncancer	5.53 (t=49)	2.93 (t=39)	11.18 (t=51)

TABLE 3

Analysis for Variance of Scores For Depression, Anxiety and Hostility Factors on the MAACL For Cancer and Noncancer Patients

	Source	df	SS	F
Factor				
Anxiety	Illness	1	14.76	1.22
Hostility	Illness	1	3.34	0.46
Depression	Illness	1	13.36	0.49

Taste Acuity

Detection

Table 4 shows the median and range of scores for detection thresholds on each taste modality for cancer and noncancer patients. Figure 2 shows the distribution of detection scores across taste modality and illness condition. There were no differences between cancer and noncancer groups on detection of hydrochloric acid (sour) or sucrose (sweet). In both cases, the range of scores for the cancer group exceeded that of the noncancer group. As shown in Figure 2, three cancer subjects detected sour at levels higher than the range for noncancer patients. Cancer patients showed a higher threshold for urea (bitter) and a lower threshold for NaCl (salty) than did noncancer patients. One cancer patient and three controls were unable to detect bitter at concentrations of 2000 mm/l.

Recognition

Table 5 shows the median and range of scores for recognition thresholds on each taste modality for cancer and noncancer groups. Figure 3 shows the distribution of recognition scores across taste modality and illness condition. There were no differences between the two groups on recognition of sour or salty. But in both cases the range of scores of cancer patients exceeded that of noncancer patients. As Figure 3 shows, one cancer subject could not recognize salt at concentrations of 2000 mm/liter. Cancer patients showed a

TABLE 4

Median and Range Scores For Detection Thresholds in mm/Liter For HCL, Sucrose, Urea and NaCl For Cancer and Noncancer Patients

Substance		Cancer	Noncancer
HCl	Median	6	6
	Range	6 - 90	6 - 12
Sucrose	Median	90	90
	Range	6 - 800	12 - 500
Urea	Median	500	300
	Range	6 - >2000	12 - >2000
NaCl	Median	75	90
	Range	12 - 800	60 - 1000

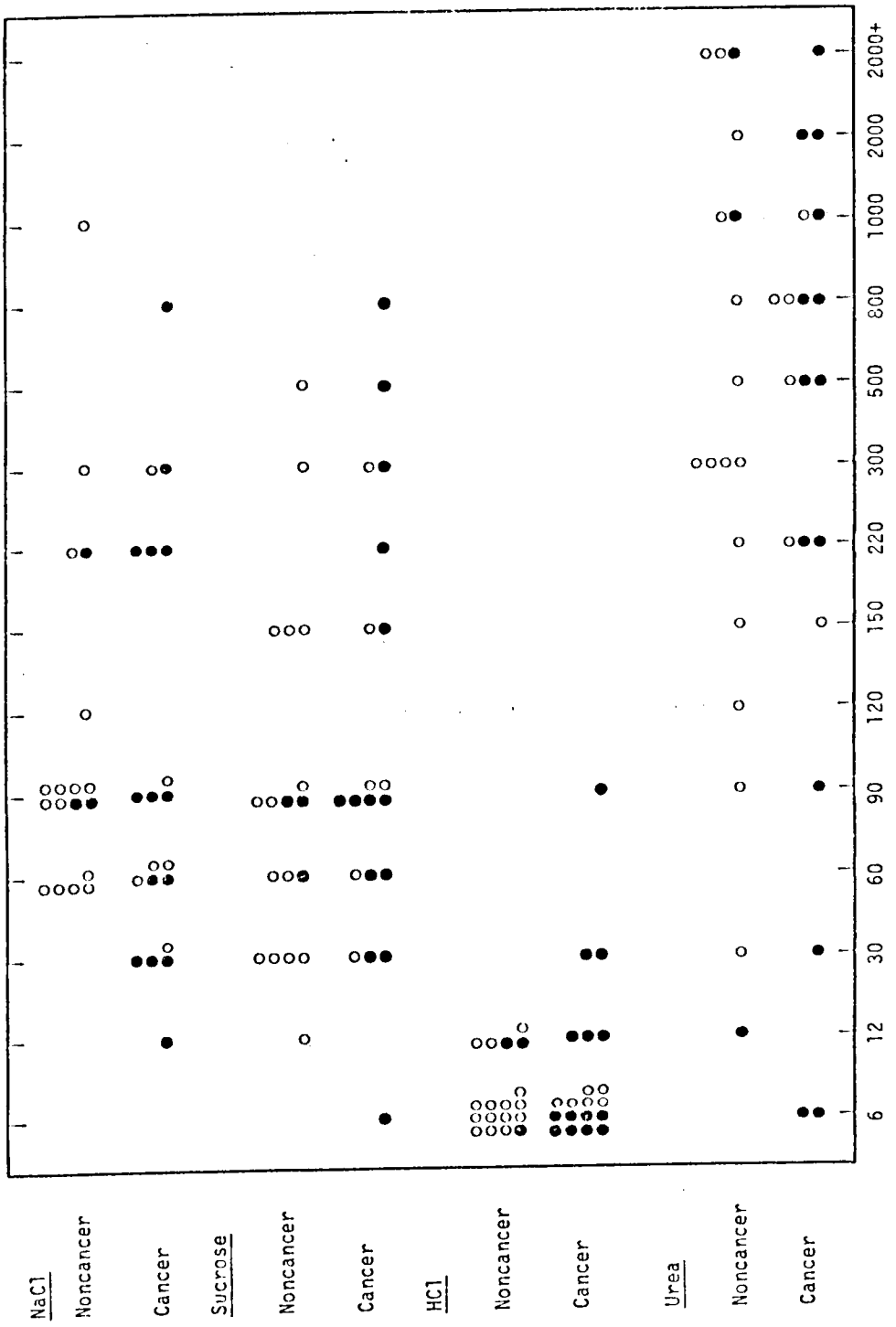

FIGURE 2

Detection Thresholds of NaCl, Sucrose, HCl and Urea for Cancer and Noncancer Patients Who Reported Appetite Difficulties (Solid Circles) or No Appetite Difficulties (Open Circles).

TABLE 5

Median and Range Scores For Recognition Thresholds in mm/Liter For HCL, Sucrose, Urea and NaCl For Cancer and Noncancer Patients

Substance		Cancer	Noncancer
HCl			
	Median	12	12
	Range	6 - 120	6 - 60
Sucrose			
	Median	150	105
	Range	30 - 800	30 - 800
Urea			
	Median	900	1000
	Range	12 - >2000	90 - >2000
NaCl			
	Median	150	150
	Range	12 - >2000	60 - 2000

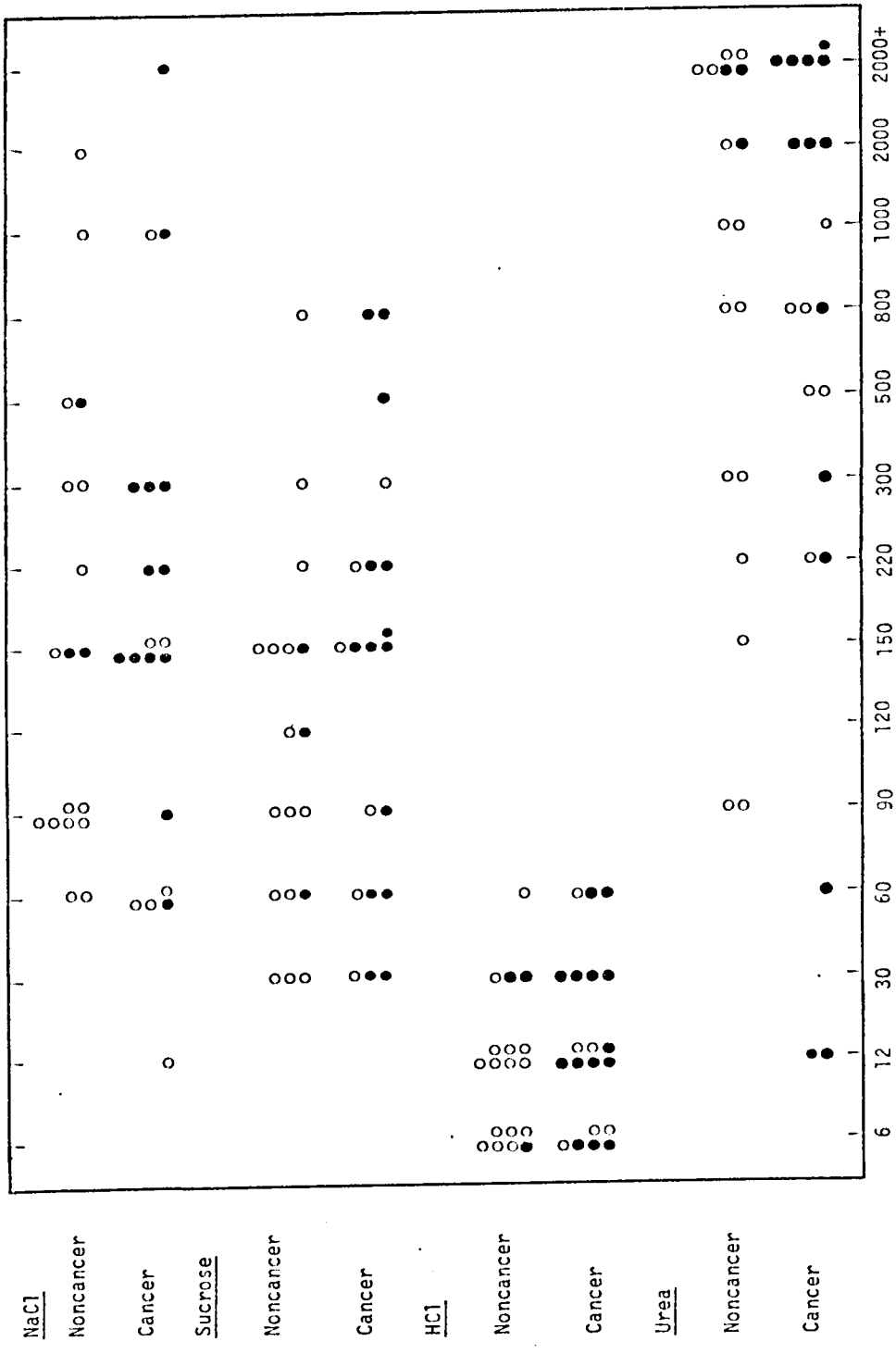

FIGURE 3

Recognition Thresholds of NaCl, Sucrose, HCl and Urea for Cancer and Noncancer Patients Who Reported Appetite Difficulties (Solid Circles) or No Appetite Difficulties (Open Circles).

higher threshold for sweet and a lower threshold for bitter than did noncancer patients. Three cancer subjects recognized bitter below the range for controls. Five cancer and six control subjects were unable to recognize bitter at concentrations of 2000 mm/l.

An ANOVA (Table 6) of the overall data for taste acuity yielded reliable effects for Flavor and Threshold. There were no reliable effects for Illness Condition, nor for the interactions involving the Illness factor. Simple effects on ANOVA comparisons evaluated differences between the flavors at detection and recognition thresholds. Table 7 shows a summary of probability levels for the reliability of these differences. Each flavor, except sweet and salty, differed significantly from the others on detection and recognition thresholds. Thresholds for sweet and salty were not significantly different from each other. Post hoc t tests were applied to evaluate the differences between detection and recognition thresholds for each flavor. Reliable differences were obtained in each case.

Salivary Responding

Figure 4 shows mean amount of salivation for cancer and noncancer patients. In general, noncancer patients showed a selective increase in salivation in the expectancy condition and higher salivation in the presence of food than they did during baseline, and more after ingestion of food than they did in the presence of food. In contrast to noncancer patients, cancer patients generally salivated less to the verbal introduction of food or food stimuli than they did during baseline, but increased above baseline after ingestion.

TABLE 6

Analysis of Variance For Detection and Recognition Thresholds for Salty, Sweet, Bitter and Sour Flavors in Cancer and Noncancer Patients

Source	df	SS	F
Illness Condition (Illness)	1	10237.81	0.03
Flavor	3	36889547.76	30.16**
Threshold	1	1854405.00	4.55*
Flavor x Threshold	3	1819987.00	1.57
Illness x Flavor	3	159067.89	0.13
Illness x Threshold	1	15318.11	0.04
Illness x Threshold X Flavor	3	26230.46	0.02

* p = < .04 ** p = < .0001

TABLE 7

Probability Levels For F-Values From
ANOVA of Differences Between Flavors
For Detection and Recognition

Detection

Flavors	HCl	Sucrose	Urea	NaCl
NaCl	.0002	.0563	.0001	--
Urea	.0001	.0001	--	.0001
Sucrose	.0001	--	.0001	.0563
HCl	--	.0001	.0001	.0002

Recognition

Flavors	HCl	Sucrose	Urea	NaCl
NaCl	.0001	.6898	.0001	--
Urea	.0001	.0001	--	.0001
Sucrose	.0001	--	.0001	.6898
HCl	--	.0001	.0001	.0001

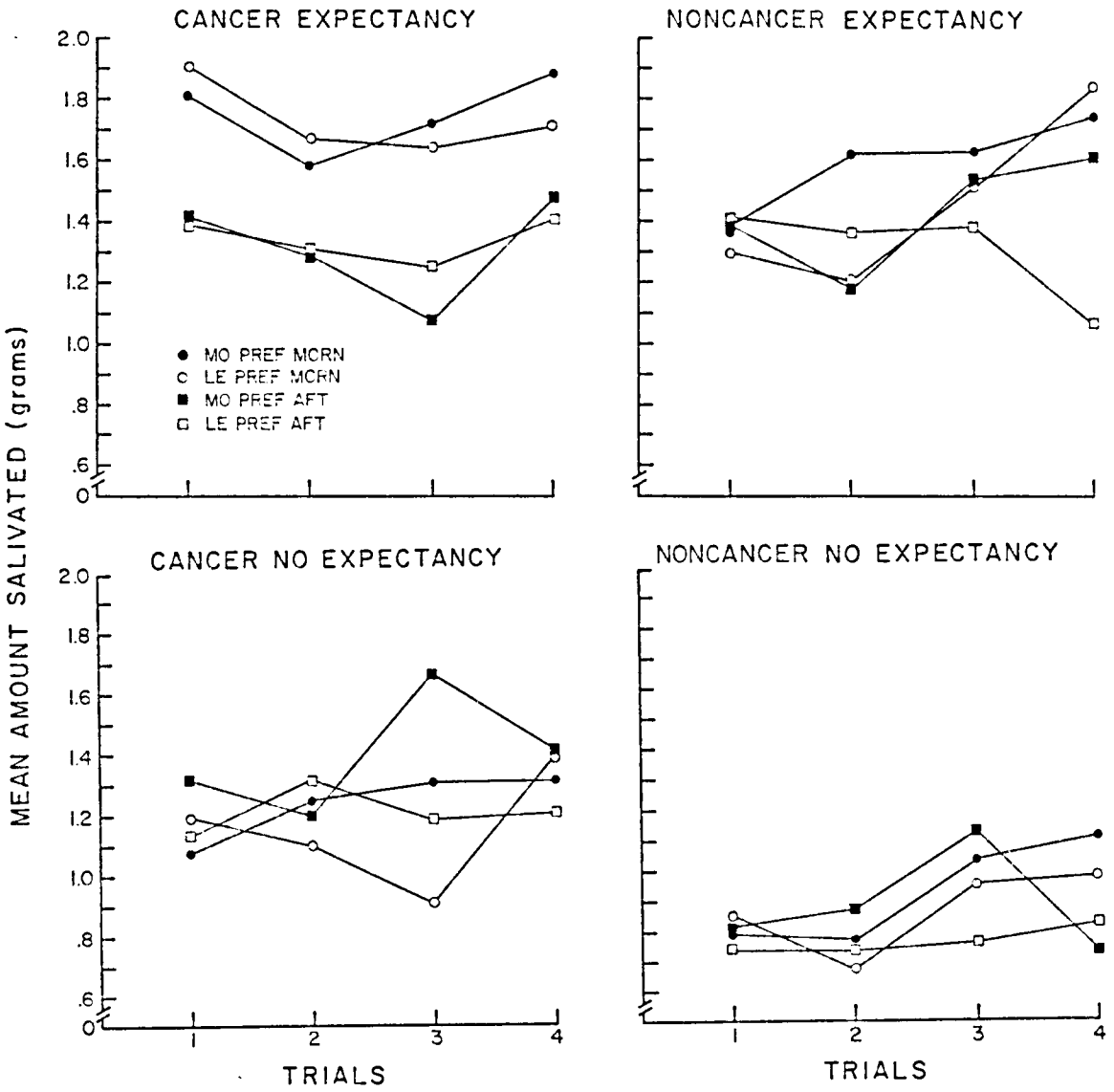

FIGURE 4

Mean Amount Salivated (g) on Trials 1 to 4 for Cancer and Noncancer Patients in Expectancy and Nonexpectancy Conditions with Most Preferred (MO PREF) and Least Preferred (LE PREF) Snacks in Morning (MORN) and Afternoon (AFT) Test Sessions.

Baseline Trials (Trial 1)

Noncancer patients in the expectancy and in nonexpectancy condition showed similar amounts of salivation in morning and afternoon baseline trials. For cancer patients, however, amount of salivation varied on baseline trials in the morning and afternoon. In the expectancy group, cancer patients showed less salivation in the afternoon than in the morning. Because the law of initial values does not apply to salivation (White, 1978; Wilder, 1967) differences in the amount of salivation at baseline between cancer and noncancer patients were not important in consideration of experimental effects.

Expectancy Trials (Trial 2)

Noncancer patients, in the nonexpectancy group, showed little change in salivation across baseline trials (1 & 2). For those in the expectancy group, priming with the most preferred food increased salivation. Priming with the least preferred food decreased salivation. However, this effect occurred only in the morning test session. In the afternoon, verbal priming decreased salivation independent of food preference.

Cancer patients, in the nonexpectancy group, showed unsystematic changes in amount of salivation across baseline trials (1 & 2). In the expectancy group however, cancer patients showed a decrease in salivation from baseline in morning and afternoon test sessions whether verbal priming occurred with the most or least preferred snack.

Food Presentation Trial (Trial 3)

When food was presented, noncancer patients in the nonexpectancy group showed increases in salivation over that from the previous trials. In the expectancy group, the amount of salivation at the presentation of food remained high in the morning test session and increased in the afternoon session at the presentation of the of the most preferred food. Salivation increased at the presentation of the least preferred food in the morning and afternoon test session. The presentation of the least preferred snack in the afternoon produced a negligible change.

For cancer patients, in general, the presentation of food produced a decrease in salivation. In the nonexpectancy group, presentation of the least preferred food produced a decrease in salivation at both times of day. Presentation of a most preferred food produced negligable change in salivation in the morning, and an increase in the afternoon. In the expectancy condition, the presence of food produced a decrease in salivation in all test trials, except for presentation of the most preferred food in the morning.

Ingestion Trials

In general, noncancer patients, in the nonexpecancy group, showed an increase in salivation after the ingestion of food. The one exception to this finding occurred in the afternoon session after ingestion of the most preferred food. In the expectancy condition,

ingestion of food produced an increase in salivation in all but one case. That is, ingestion of a least preferred food in the afternoon produced a decrement in salivation.

Ingestion of the most preferred food produced greater salivation then ingestion of the least preferred food.

In contrast, for cancer patients, in the nonexpectancy condition, ingestion of a most preferred food produced little change in salivation. Ingestion of a least preferred food in the morning session produced an increase in salivation. In the afternoon, ingestion of a most preferred food produced a distinctive decrease in salivation. Ingestion of a least preferred food produced little change in salivation. In the expectancy condition salivation was related to food preference and time of day. Ingestion of a most preferred food produced a greater increase in salivation than did ingestion of a least preferred food.

An ANOVA over all the salivation data (Table 8) yielded reliable main effects for Expectancy and Trial, but not for Illness Condition or interactions involving the Illness Condition.

Since reliable effects were obtained for Trials, further analysis was done for comparisons between trials on expectancy and illness conditions. Analysis compared trials 1 and 2, 2 and 3, and 3 and 4 in the morning and afternoon test session. Effects which were found to be reliable are presented in Table 9. All unreliable effects occurred with a probability of greater than .08 at least. ANOVA yielded reliable effects for the Expectancy factor on all test trial comparisons in the morning and afternoon except for the trials 2-3

TABLE 8

Analysis of Variance of Amount Salivated (mgm) to Most Preferred and Least Preferred Snacks by Cancer and Noncancer Patients in Expectancy and Non Expectancy Conditions On Trials 1-4 In Morning and Afternoon Test Sessions

Source	df	SS	F
Illness	1	7.15	2.00
Expectancy	1	30.78	8.60**
Order	1	11.42	3.19
Illness x Expectancy	1	3.61	1.01
Illness x Order	1	6.68	1.87
Expectancy x Order	1	10.47	2.93
Trial	3	4.07	6.62
Illness x Trial	3	1.43	2.32*
Expectancy x Trial	3	0.58	0.94
Order x Trial	3	0.46	0.75
Illness x Expectancy x Trial	3	0.43	0.71
Illness x Order x Trial	3	0.22	0.37
Preference	1	0.52	2.04
Illness x Preference	1	0.01	0.05
Expectancy x Preference	1	0.09	0.33
Order x Preference	1	0.30	1.16
Illness x Expectancy x Preference	1	0.40	1.33
Illness x Order x Preference	1	0.07	0.27

* = $p < .078$ ** = $p < .006$ *** = $p < .0005$

TABLE 9

Reliable effects for analysis of variance for trial by trial comparison of amount of salivation in the morning and afternoon by cancer and non-cancer patients in expectancy and non-expectancy conditions.

	Trials	SOURCE	df	SS	F
Morning					
	1 - 2	Expectancy	1	13.08	4.83**
	2 - 3	Expectancy	1	11.05	4.58**
		Illness & Trials	1	0.46	3.46*
	3 - 4	Expectancy	1	11.81	4.85*
		Trials	1	1.01	4.38*
Afternoon					
	1 - 2	Expectancy	1	4.88	5.64*
	2 - 3	Illness x Expectancy	1	4.81	5.30*
		Trials	1	0.38	4.30*
	3 - 4	Expectancy	1	3.36	3.91*
		Illness x Expectancy	1	4.50	5.23*

* = $p < .07$ ** = $p < .005$

comparison in the afternoon. The effect Trials was reliable for the trial 3-4 comparison in the morning and the 2-3 comparison in the afternoon. The interaction of Illness condition and Expectancy was reliable on the trial comparison 2-3 and 3-4 in the afternoon. The interaction of Illness Condition and Trials was reliable for the trial comparison 2 and 3 in the morning. No reliable effects were obtained for illness condition. The reliable effects of Expectancy which were found in the overall analysis were also found in the trial by trial comparisons.

DISCUSSION

Appetite Difficulties

The present results suggest that cancer patients are more likely to have difficulty with eating behavior than are noncancer patients. All but six cancer patients reported appetite difficulties, the most frequent complaints being premature satiety and decreases in food intake. These findings coincide with those of previous studies by DeWys and Walters (1975) and by Nielson et al. (1980). Nielson et al. reported that 51% of cancer patients indicated decreases in appetite and 62% exhibited early satiety. DeWys and Walters reported that nearly half of the cancer patients tested indicated a loss of pleasure in tasting and eating food. However, these studies included data from patients who had been treated with chemotherapy. Since chemotherapy causes appetite changes (Bernstein & Webster, 1981), reports of appetite difficulties by cancer patients in DeWys and Walters and in Nielson et al., may have been affected by the chemotherapy experience. In the present study, appetite difficulties were measured in patients prior to chemotherapy. Therefore, the results are not likely attributable to the confounding of cancer and (chemotherapy) treatment. Present data most likely reflect the influence of the illness per se.

Affect Ratings

Cancer patients did not differ reliably from noncancer patients on the depression, anxiety, and hostility factors of the MAACL. In fact, only one cancer patient was classified as depressed on the MAACL. Anecdotal evidence (e.g., nurses' comments) indicated that cancer patients did not exhibit depression-like characteristics in their verbal or nonverbal (e.g., locomotor) behavior. Results of the MAACL are consistent with those of Holland, Rowland and Plumb (1972). These investigators compared scores on the Beck Depression Inventory (BDI) for patients who had advanced cancer, the patients' closest relatives, and for depressed psychiatric patients. On items which reflected physical symptoms, such as anorexia, weight loss and fatigue, cancer patients yielded BDI scores which were similar to those of psychiatric patients. On items which reflected nonphysical symptoms, such as loss of self esteem, guilt and pessimism, cancer patients scored in the low BDI range, and were similar in scoring to their relatives. Other investigators (e.g., Massie & Holland, 1984) have suggested that cancer patients are no more likely to be depressed than are patients who are equally physically-ill with other diseases. The present data for the MAACL suggest that differences in appetite between cancer and noncancer patients are not likely to be attributable to differences in affect.

Taste Acuity

Taste acuity of cancer patients differed from that of noncancer patients on some taste modalities. Specifically cancer patients showed

a higher detection threshold for the taste of bitter and a lower detection threshold for the taste of salt than did noncancer patients. Unfortunately, these differences were not reliable, and in light of the data on appetite difficulties, these results are surprising. Present results do not coincide with previous data on taste acuity from Carson and Gormican (1977), DeWys and Walters (1975), Gorshein (1977), and Williams and Cohen (1978). DeWys and Walters (1975) and Gorshein (1977) reported an increase in threshold for the tastes of sweet and bitter. Williams and Cohen (1978) reported a decrease in the taste threshold for sour. Carson and Gormican (1977) reported an increase in the threshold for salt. However, although these studies reported differences in taste thresholds between cancer and noncancer patients it should be noted that their reports of acuity differences were not consistent with each other. For example, in contrast to DeWys and Walters (1975) and Gorshein (1977), Carson and Gormican (1977) and Williams and Cohen (1978) reported no differences in thresholds to the taste of sweet and bitter. Further, it is possible that the previous data on taste acuity (e.g., DeWys & Walters, 1977) may reflect the particular subject characteristics of the cancer and/or hospitalized patients. That is, earlier studies obtained data from female patients (Carson & Gormican, 1977; DeWys & Walters, 1975), from normal healthy control subjects (DeWys & Walters , 1975; Williams & Cohen, 1977), from nonsmokers (DeWys & Walters, 1975), and from patients who were undergoing chemotherapy (Carson & Gormican, 1977; DeWys & Walters, 1975). The present study obtained data from male patients, hospitalized noncancer controls, and cancer patients who had not

received chemotherapy. Eighty-seven percent of the subjects in the present study were smokers or had smoked in the past. They smoked an average of more than one pack of cigarettes a day and had a thirty-eight year history of smoking. Since a majority of the patients at the Veterans Administration Medical Center smoke, smokers could not be reasonably excluded from the study. Jackson (1967) reported that smokers have as much as a fourteen fold rise in taste threshold compared to nonsmoking controls. Thus, patients in the present study may have had elevated taste thresholds which were independent of the effects of cancer.

Salivary Responding

Salivation in cancer patients did not differ reliably from that of noncancer patients. In light of the reports of appetite difficulties by cancer patients, these results are surprising. Conditions which affect appetite generally decrease salivation. For example, nutrient preloading, satiety, appetite suppressant drugs such as amphetamine, and anxiety decrease salivation in the presence of palatable foods (Wooley & Wooley, 1981). Booth and Fuller (1981) found that the salivary response positively corelated as well with ratings of hunger, food pleasantness and amount of food desires as these tastings correlated with each other. Wooley and Wooley (1973) found that salivary response to food stimuli correlated positively with the subjects' ratings of hunger and food appeal. Since a large proportion of the cancer patients in this study reported appetite difficulties it

was expected that they would salivate significantly less to food and food-related stimuli then would noncancer patients.

It may be that in the present experiment particular characteristics of he test procedure precluded an adequate test of the effect of food and food related stimuli on salivation. The overall lack of a systematic effect for food and food related stimuli may be due to an insufficient degree of hunger in both the cancer and noncancer patients. The test sessions were conducted approximately two hours after breakfast and two hours after lunch. These times were chosen to provide controlled deprivation conditions without altering the usual feeding pattern of the patient. However, two hours may have been too short a deprivation interval to establish the minimal level of hunger necessary to elicit a reliable increase in salivation. Further, while length of deprivation affects appetite and salivation (Wooley & Wooley, 1981), appetite is also affected by a range of external events, such as time of day, the social environment and the presence of stimuli associated with eating. For example, the test sessions did not coincide with the patients customary mealtime nor was testing conducted while other patients were eating. Consequently, social cues which may be related to eating were not present during the test session. Further, the usual accoutrements of eating, such as utensils, meal trays and glasses were not present during testing. Therefore, it may be that the relatively short interval of food deprivation, and the lack of external and social cue which normally accompany mealtime contributed to the the small changes in salivation which occurred in the cancer and noncancer patients.

However, despite these small changes in salivation the interaction between Illness Condition and Test Trial during the presentation of food approached significance. The presentation of food increased salivation for noncancer patients but decreased salivation for cancer patients. Since these effects were not reliable, conclusions drawn from them should be considered as being speculative. Accordingly, the decrement in salivation during the presentation of food for cancer patients may reflect the previous establishment of aversive properties to food and food related stimuli. According to the traditional model of taste aversion conditioning (Garcia, Kimeldorf & Koelling, 1955), foods which accompany illness-inducing procedures lead to the establishment of an aversion (i.e. avoidance tendencies) to the food. For example, laboratory animals (rats) which have received a pairing of a sweet flavor (e.t.sucrose) with an injection of a toxin, such as lithium chloride, subsequently ingest less of the flavor than do animals which were not exposed to the flavor-toxin contigency (Garcia, Kilerldorf & Koelling, 1955). Bernstein (1987) and Bernstein and Webster (1981) have demonstrated the establishment of a conditioned aversion in cancer patients following the pairing of food with chemotherapy. Bernstein and Sigmundi, (1980) demonstrated the establishment of a conditioned aversion in rats to foods ingested during tumor growth. In cancer patients, food and food related stimuli may acquire aversive properties as a consequence of being paired with the aversive physiological effects of the tumor itself (i.e., unpleasant symptoms such as delayed gastric emptying etc.).

The negative properties evoked by the presentation of food may be attenuated by actual ingestion of food. Ingestion of food yielded a similar increase in salivation in cancer patients and noncancer patients.

Suggestions for Food Presentation for Cancer Patients

While differences in salivation in cancer and noncancer patients did not reach statistically significant levels, the data may be clinically significant. On that basis the following suggestions may be applied to facilitate eating behavior in cancer patients.

1. Foods which are frequently ingested during the onset and advancement of illness may be more likely to acquire aversive properties than are foods less frequently ingested. Varying the diet of the cancer patient by offering palatable but not frequently chosen foods or by offering foods less often may decrease the incidence of conditioned taste aversions.
2. Most hospital schedule meals at predictable times and, beforehand they offer the patients a menu from which to choose. Regular mealtimes and foreknowledge of the contents of the meal are similar to conditions which may promote the development of an aversion. Therefore, expectation of mealtime and the actual food to be served should be limited by: (a) varying mealtime, (b) allowing patients to select their meals at least a day in advance of the day they are to be served, and (c) not informing the patient about the contents of a meal until it is actually served.

3. Repeated pairing of food and discomfort may strengthen the aversive properties of food. Association of food with responses which are incompatible with discomfort may weaken a conditioned aversion to food. Therefore, patients should be encouraged to eat while engaging in preferred activities, such as watching television, reading or conversing with others.
4. Appetite difficulties in cancer patients may be related mainly to anticipation of eating and not to ingestion itself. Since ingestion of a small amount of food evokes salivation, serving an appetizer to the cancer patient a short time before a meal is presented may counter any aversive properties of food and facilitate eating.

Suggestions for Future Research

The results of the present study suggest that cancer patients may respond differently then noncancer patients to the presentation of food. This hypothesis may be tested more directly by 1) controlling for the length of food deprivation 2) testing during the usual mealtime of the patients, and 3) testing in the presence of the usual accoutrement of eating.

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APPENDIX A

SUBJECT CHARACTERISTICS

Subject	Age	Illness	Smoking	Appetite Difficulties
Cancer				
1	64	Bone Cancer	Yes	No
2	63	Lymphoma	Yes	No
3	61	Lung Cancer	Yes	Yes
4	60	Lung Cancer	Quit	Yes
5	76	Prostate	Quit	Yes
6	88	Prostate	No	Yes
7	55	Lung Cancer	Yes	Yes
8	43	Lung Cancer	Yes	Yes
9	65	Lung Cancer	Yes	Yes
10	57	Lung Cancer	Quit	No
11	71	Lung Cancer	Quit	Yes
12	63	Lung Cancer	Quit	Yes
13	64	Lung Cancer	Yes	No
14	58	Prostate	No	Yes
15	72	Lung Cancer	Yes	Yes
16	63	Lung Cancer	No	Yes
17	70	Lung Cancer	Yes	Yes
18	81	Lung Cancer	Yes	Yes
19	72	Vocal Cord Cancer	Quit	No
20	70	Lung Cancer	Quit	No

SUBJECT CHARACTERISTICS

Subject	Age	Illness	Smoking	Appetite Difficulties
Noncancer				
21	64	Back pain	Yes	No
22	42	Hypertension	Yes	No
23	67	Hemorrhoids	Quit	No
24	41	Tilia fracture	No	No
25	52	Callus, right foot	Yes	No
26	64	Back pain	Yes	No
27	69	Gallstones	Quit	No
28	71	Leg ulcer	Quit	No
29	62	Foot swelling	Yes	No
30	58	COPD	Quit	No
31	71	Possible CVA	Yes	No
32	62	Lytic lesion	Yes	No
33	45	Benign abdominal tumor	No	No
34	63	Pain, left toe	Quit	Yes
35	62	Infected skin graft	Yes	No
36	66	Foot ulcer	Yes	No
37	54	Gallstones	Yes	Yes
38	53	Back pain	Yes	Yes

APPENDIX B

MEDICATIONS FOR CANCER AND NONCANCER PATIENTS

Subject	Medication
Cancer	
1	Multivitamin
2	Acetaminophen Temazepam capsules Slow K
3	Ibuprofen
4	Ibuprofen AcetamInophen Triazolam Pentaxocine hydrochloride Doxidan
5	Magnesium & aluminum tablet Heparin soduim Ibuprofen Doxidan
6	Digoxin Nitroglycerin Dipyridamole
7	Hydroxyzine pamoate Acetaminiphen Pentazocine lydochloride Leuothyroxine sodium
8	Indomethacin
9	Multivatamin
10	Acetaminophen Termazapam
11	Acetaminophen Oxycodone

MEDICATIONS FOR CANCER PATIENTS (continued)

Subject	Medication
Cancer	
12	Acetaminophen Oxycodone Ethabutal
13	Nitroglycerin Diazepam Robitussin
14	Acetaminophen
15	Amoxicillin
16	Aminophyllin
17	Acetaminophen
18	None
19	None
20	Temazepam Magnesium & aluminum tablet Acetaminophen

MEDICATIONS FOR CANCER AND
NONCANCER PATIENTS

Subject	Medication
Noncancer	
21	Acetaminophen
22	Docusate sodium Propranoloh hydrochloride Diazepam
23	Chloral hydrate Oxyphen butazone Acetaminophen
24	Flurazepam hydrochloride Acetaminophen Heparin sodium Magnesium hydroxide
25	Prioxicam
26	None
27	Hydroxyzine pamoate Acetaminophen Triamtercne + hydrochlorothizide dyazide
28	Prednisone Trimolol maleate, MSD Ibuprofen
29	Ibuprofen Trizolam
30	Anhydrous theophylline
31	Prednisone

MEDICATIONS FOR CANCER AND NONCANCER PATIENTS (continuted)

Subject	Medication
Noncancer	
21	Acetaminophen
22	Docusate sodium Propranolol hydrochloride Diazepam
23	Chloral hydrate Oxyphen butazone Acetaminiphen
24	Flurazepam hydrochloride Acetaminiphen Heparin sodium Magnesium hydroxide
25	Prioxicam
26	None
27	Hydroxyzine pamoate Acetaminophen Triamtercne + hydrochlorothizide dyazide
28	Prednisone Trimolo maleat, MSD Ibuprofen
29	Ibuprofen Trizolam
30	Anhydrous theophylline
31	Prednisone

MEDICATIONS FOR CANCER AND NONCANCER PATIENTS (continued)

Subject	Medication
Noncancer	
32	Codeine phosphate + acetaminophen Magnesium hydroxide Ducolax suppositories, bisarodyl Temazepam capsules
33	Dicyclomine Metamucil Milicon - simethicone
34	Ibuprofen
35	Oxycodone hydrochloride Magnesium hydroxide Alprazolam Digoxin Multivitamin
36	Pentazocine hydrochloride Chlorthalidone Digoxin Acetaminophen Ibuprofen
37	None
38	Multivitamin

APPENDIX C

Recruitment of Potential Subjects

Some patients experience changes in what they like to eat and how food tastes to them. We are trying to discover why some of these changes occur. If we can identify some of the reasons for these changes we may be able to help patients plan diets which are more pleasurable for them.

We have begun a study of taste sensitivity and salivation here in this hospital and I would like you to participate. It would involve three measurement sessions over two days. On the first day I will be giving you solutions to taste and I will ask you to identify them as to salty, bitter, sweet or sour. This session will last about thirty minutes. On the second day there will be a morning and afternoon session. These will last about forty minutes each. During these sessions I will ask you to place dental rolls in your mouth. The rolls will stay in for only two minutes at a time. If they are uncomfortable you can take them out right away. Most people don't mind them, however. The rolls will help us measure your salivary response. We will take a number of measures at each session.

I would like you to participate in the project. Your participation is entirely voluntary. You may quit anytime. Would you be interested in participating? (If subject responds "yes") Good. Here is an informed consent form which I would like you to read and sign. (Consent form read aloud. Subject is given a copy of form to take home.)

APPENDIX D

Potential Subject Information Form

Name_____ Height_____

Age _____ Weight_____

SMOKING HISTORY (Check all applicable. Includes cigarettes, cigar, chewing tobacco, pipe.)

1. I presently do not and never have smoked
2. I presently smoke
   a) Type(s) of tobacco used
   b) Amount of tobacco used daily
   c) Length of time I have smoked
3. I presently do not smoke, but have quit smoking
   a) Type(s) of tobacco used
   b) Amount of tobacco once used
   c) Total number of years I smoked
   d) Length of time since I quit.

For the following questions, please check the most appropriate answer.

1. Do you drink three (3) or more ounces of whiskey (or any hard liquor) daily?
2. Do you drink one or more bottles of wine daily?

3. Do you drink six (6) or more 12 ounce cans of beer daily?

4. Are you on any diet restrictions other than modifications of texture (texture modifications include: bland, soft, fiber, puree, or ground)?

5. Do you presently wear dentures?

6. Do you have any of the following diseases or illnesses?

   a) Kidney failure

   b) Liver disease

   c) Known vitamin deficiency

   d) Diabetes

   e) Excessive dry mouth

   f) High blood pressure

7. Do you take any of the following medications?

   a) Muscle relaxants

   b) Cocaine

   c) Anti-epiletic drugs (seizure medication)

   d) Amphetamines (speed pills, or breathing medications)

   e) Fluid pills (diuretics)

   f) Insulin

   g) Aspirin

Medication _____

_____

_____

Diagnoses _____

_____

No previous chemotherapy or radiation therapy? _____

Date of form completion _____

Time of day _____

Taste Sensitivity Questionnaire

1. Has your appetite changed recently?

   No _____ Yes _____

   If yes, has it Increased _____

   Decreased _____

2. Do you get full with less food?

   No _____ Yes _____

   If yes, which ones? _____

4. Do you have difficulty eating at any particular time of day or meal?

   No _____ Yes _____

   If yes, when? _____

APPENDIX G

Food Preference List

The following is a list of frequently encountered snacks. Most people have certain snacks which they like very much and others which they like less or dislike. Please circle the number which best describes how much you like the following snacks on a scale of 1 (like very much, a favorite snack) to 5 (dislike very much, a least favorite snack).

	Like very much		Indifferent		Dislike very much
	1	2	3	4	5
Potato chips	1	2	3	4	5
Chocolate cookie	1	2	3	4	5
Pretzels	1	2	3	4	5
Coffee cake	1	2	3	4	5
Lemon cake	1	2	3	4	5
Corn chips	1	2	3	4	5
Cheese doodles	1	2	3	4	5
Butter cookie	1	2	3	4	5
Popcorn	1	2	3	4	5
Cracker	1	2	3	4	5

APPENDIX F

Instructions for Taste Acuity Test

Before we begin, please rinse your mouth with this water. Now, I will place three drops of solution on your tongue. If any one drop of solution taste different from the other two, please respond by saying which drop tastes different. Remember, it's all right to say there is no difference. We'll just proceed on. If you do detect a difference in the taste of one drop and can identify it, please do so. The drop will be sweet, sour, bitter or salty. Sweets are sugars and starches. Sour tastes tart, like lemon or lime. Bitter foods are like coffee or cafeine. And salty tastes like table salt. Do you have any questions: Good. Let's begin.

APPENDIX E

Date _____

PATIENT CONSENT FORM

Information About: Taste Acuity and Salivary Response

I _____ hereby agree to participate in the study named above.

The purpose of the study has been explained to me. I will fill out a questinnaire about my food preferences and my recent pattern of eating. I will participate in a total of three measurement sessions over two days; a taste acuity session on Day 1 and two salivary measurement sessions on Day 2, one in the morning and one in the afternoon. On Day 1, I will be given solutions to taste and will identify them as salty, sweet, bitter or sour. This session will last about thirty - forty minutes. On Day 2 I will be asked to place dental rolls in my mouth so my salivary response can be measured. The dental rolls will remain in my mouth for two minutes. If they cause any discomfort I may remove them immediately. My salivary response will be measured a number of times during each session on Day 2. Each session will last approximately thirty - forty minutes.

The research in which I will participate has been approved by the Human Subjects and Research Committees of the VA Medical Center, Salem, VA.

All information obtained in the study will be held strictly confidential and will be used for statistical purposes only. My name will not be disclosed in any publication.

I understand that I will be asked personal questions about my health history, medications and drug use and the information obtained will be kept in the researcher's file.

I understand that my participation in this study is voluntary and that I may withdraw this consent and discontinue participation at any time. I was advised that the risks involved in the taste acuity and salivation study are considered essentially non-existant; but in the event of injury as a result of my participation, I can expect no compensation. I also understand that any veterans benefits to which I am entitled to will not be effected by my participation or withdrawal from the study.

I was told that if I had any questions about the study or the procedures I can contact Ms. Alice Friedman, Dr. Franchina, or Dr. Jain ('.

_____

SUBJECT'S SIGNATURE

_____

INVESTIGATOR'S SIGNATURE

APPENDIX H

The Multiple Affect Adjective Check List

MULTIPLE AFFECT ADJECTIVE CHECK LIST

IN GENERAL FORM

By Marvin Zuckerman
and
Bernard Lubin

Name..... Age..... Sex.....

Date..... Highest grade completed in school.....

DIRECTIONS: On this sheet you will find words which describe different kinds of moods and feelings. Mark an ☒ in the boxes beside the words which describe how you generally feel. Some of the words may sound alike, but we want you to check all the words that describe your feelings. Work rapidly.

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1 ☐ active
2 ☐ adventurous
3 ☐ affectionate
4 ☐ afraid
5 ☐ agitated
6 ☐ agreeable
7 ☐ aggressive
8 ☐ alive
9 ☐ alone
10 ☐ amiable
11 ☐ amused
12 ☐ angry
13 ☐ annoyed
14 ☐ awful
15 ☐ bashful
16 ☐ bitter
17 ☐ blue
18 ☐ bored
19 ☐ calm
20 ☐ cautious
21 ☐ cheerful
22 ☐ clean
23 ☐ complaining
24 ☐ contented
25 ☐ contrary
26 ☐ cool
27 ☐ cooperative
28 ☐ critical
29 ☐ cross
30 ☐ cruel
31 ☐ daring
32 ☐ desperate
33 ☐ destroyed
34 ☐ devoted
35 ☐ disagreeable
36 ☐ discontented
37 ☐ discouraged
38 ☐ disgusted
39 ☐ displeased
40 ☐ energetic
41 ☐ enraged
42 ☐ enthusiastic
43 ☐ fearful
44 ☐ fine
45 ☐ fit
46 ☐ forlorn
47 ☐ frank
48 ☐ free
49 ☐ friendly
50 ☐ frightened
51 ☐ furious
52 ☐ gay
53 ☐ gentle
54 ☐ glad
55 ☐ gloomy
56 ☐ good
57 ☐ good-natured
58 ☐ grim
59 ☐ happy
60 ☐ healthy
61 ☐ hopeless
62 ☐ hostile
63 ☐ impatient
64 ☐ incensed
65 ☐ indignant
66 ☐ inspired
67 ☐ interested
68 ☐ irritated
69 ☐ jealous
70 ☐ joyful
71 ☐ kindly
72 ☐ lonely
73 ☐ lost
74 ☐ loving
75 ☐ low
76 ☐ lucky
77 ☐ mad
78 ☐ mean
79 ☐ meek
80 ☐ merry
81 ☐ mild
82 ☐ miserable
83 ☐ nervous
84 ☐ obliging
85 ☐ offended
86 ☐ outraged
87 ☐ panicky
88 ☐ patient
89 ☐ peaceful
90 ☐ pleased
91 ☐ pleasant
92 ☐ polite
93 ☐ powerful
94 ☐ quiet
95 ☐ reckless
96 ☐ rejected
97 ☐ rough
98 ☐ sad
99 ☐ safe
100 ☐ satisfied
101 ☐ secure
102 ☐ shaky
103 ☐ shy
104 ☐ soothed
105 ☐ steady
106 ☐ stubborn
107 ☐ stormy
108 ☐ strong
109 ☐ suffering
110 ☐ sullen
111 ☐ sunk
112 ☐ sympathetic
113 ☐ tame
114 ☐ tender
115 ☐ tense
116 ☐ terrible
117 ☐ terrified
118 ☐ thoughtful
119 ☐ timid
120 ☐ tormented
121 ☐ understanding
122 ☐ unhappy
123 ☐ unsociable
124 ☐ upset
125 ☐ vexed
126 ☐ warm
127 ☐ whole
128 ☐ wild
129 ☐ willful
130 ☐ wilted
131 ☐ worrying
132 ☐ young

APPENDIX I

Instructions for Salivation Measure

As you know, I am going to be measuring your salivation a number of times today. To do this I will be asking you to put dental rolls in your mouth and keep them there for two minutes at a time. I'll tell you when to take them out. First, let me tell you how to put them in your mouth. I'll be giving you a bag like this with three dental rolls inside. Take the rolls out like this and put one next to your gums along here (demonstrate to subject by pointing to own gums) on this side. Another right here on this side (demonstrate by pointing to other side) and the third across your mouth like this (demonstrate by pointing). When you have three rolls in your mouth it's very important to sit still and not to attempt to talk. If they get uncomfortable before I ask you to take them out, go ahead and remove them. Otherwise I'll tell you when it is time to take them out. Use these tweezers to take the rolls out of your mouth, or drop them into the bag. Put the rolls in the bag.

(Hand subject a plastic bag containing 3 dental rolls. Place tweezers on table.) Go ahead and put the dental rolls in your mouth for a sample trial. (Check to be sure the rolls are properly placed.

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