

Portion-Controlled and Tailored Food Offerings for Cancer Patients Undergoing Treatment: A Pilot Study Identifying Characteristics of those Requesting them

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RESEARCH

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ABSTRACT

Cancer patients actively undergoing treatment are often not recipients of dietary counseling, yet experience fatigue and food aversions that lead to weight loss. The Cancer Nutrition Consortium is an organization that funds research related to nutritional issues that affect those undergoing cancer treatments. Based on these studies, Hormel Health Labs created easy-to-prepare food and beverage offerings to meet the unique, and short-term nutritional needs of these cancer patients. These included meals (beef, chicken, and vegetarian), shakes (chocolate and vanilla), and a protein powder. The purpose of this pilot study was to determine patient characteristics of those requesting these items using a survey to capture information about the patient and how they liked the food

offerings.

One hundred thirty-seven cancer patients undergoing treatment (79% female) were provided the special foods and beverages, and resided in 38 of the 50 States in the United States. Of this group, 125 completed the survey and had a mean age of 56 ± 14 years. The most common type of cancer represented was breast (45%) followed by cancer of the reproductive system (12%). Nearly half (43%) reported having more than one treatment (e.g., chemo- and radio-therapy, surgery). Most participants experienced a decreased appetite (69%), dry mouth (74%), and food aversion (74%). More than half (53%) lost weight.

Using a rating scale of one (worst) to five (best), all offerings had at least mean scores of 3.50. The highest rated offerings were the two shakes and two meals (beef and chicken). More than 80% of the participants were able to consume most of the shakes, and 75% of the group was able to consume most of the meals. About half of the participants stated they felt pleasantly full after consuming all the food offerings except, as expected, after the protein powder, due to its comparatively low energy content. Gastric-related side effects were nearly non-existent (fewer than 4% of the group reporting any discomfort). Nearly all (96%) of the participants rated the food offerings were a nutritional asset.

Easy-to-prepare food offerings, tailored to meet the nutritional needs of patients undergoing cancer treatment, were well received, satisfying, and produced virtually no side effects. Patients with a variety of types of



cancer would likely benefit from using these food offerings based on the current findings.

Key Words: cancer treatment diets, nutrition during cancer treatment, nutrition and cancer.

INTRODUCTION

The National Cancer Institute estimates that in 2020, nearly 2 million people will be diagnosed with cancer and 600,000 will die from the disease [1]. Nutrition is important for reducing the risk of developing cancer, and for preventing and treating malnutrition during and after treatment. Most nutrition and cancer research focuses on prevention [2, 3]. This is understood because 30-40 percent of cancers could be prevented by changes in dietary and lifestyle measures. Most notable is the positive relationship between obesity and the incidence of many cancers including those of the breast, ovaries, colon, and pancreas [4]. As 42% of the U.S. population is obese, the incidence of these cancers will likely remain significant [5].

In contrast, scientific studies about diet during cancer treatment are lacking. One review on nutrition during cancer treatment focused primarily on dietary treatments for severe malnourishment, rather than on most patients who have not achieved a significant weight loss [6]. Admittedly, the duration of time cancer patients undergoing active treatment is short and episodic, so the impact of diet on nutritional status varies widely. Chemotherapy may last six months to one year with actual treatments usually occurring in a cycle with one day each week of receiving chemotherapy, having no treatment for three weeks, and then having another treatment [7]. The most common radiation therapy, external beam radiation therapy, is typically administered once a day, five days a week, for two to ten weeks [8]. Hence, the lack of nutritional counseling for these patients is understandable because treatments are short.

Cancer Nutrition Consortium

To fill the scientific void, the Cancer Nutrition Consortium (CNC) was formed in 2013 to investigate nutrition-related complications during cancer treatment (<https://www.cancernutrition.org>). In addition, the CNC provides recipes and nutritional recommendations for patients undergoing cancer treatment.

The first research study of the CNC involved surveying 1,199 patients from seven cancer treatment centers around the U.S. [9]. Each participating center stated that this group of patients did not usually receive dietary counseling. On a single visit to a treatment center, the participants were asked to complete a 15-minute, paper-and-pencil survey about dietary habits during and around treatment. The most salient findings were that 75% of the group reported feeling fatigue and having less energy, 40% having a reduced appetite, and 45% experiencing weight loss.

In addition, 67% of all participants reported at least one chemosensory change, such as changes in taste sensitivities (e.g., saltiness, sweetness, metallic) and an aversion to specific foods (e.g., spicy, fried/greasy) [9]. Participants, who lost at least five pounds, were more likely to have food aversions, potentially exacerbating weight loss. Aversions to foods and taste sensitivities varied by type of cancer diagnosis and treatment (e.g., GI cancer patients were more sensitive to aromas of food cooking than those with other types of cancer).

Next, the CNC explored nutrition-related issues in a subset of cancer patients undergoing treatment, who were at least 55 years of age (800 of the 1,199 from the aforementioned study) [10]. The findings from this older cohort mimicked the finding of the entire group: about 40% of the elderly group reported fatigue and reduced appetites.

Subsequent studies funded by the CNC related to changes in taste and smell perceptions in head and neck cancer patients during and after treatment with radiation therapy, with or without chemotherapy [11-13]. Pain and mucositis were the most common side effects related to nutritional intake, and the strongest food aversions were to spicy and pungent foods [11]. The participants lost 5% body weight during treatment and 12% afterwards. Further

assessment of this group of head and neck cancer patients revealed that 50% of the group experienced a loss of appetite and taste during treatment, which increased afterwards to affect 62% of the subjects [12]. The most common complaint was throat and mouth pain, which was present in 67% of participants during treatment and in 42%, post-treatment.

These findings demonstrated that there is a need for specially-tailored food offerings for patients undergoing treatment for cancer to overcome food aversions and fatigue so as to limit weight loss. The CNC developed criteria for single servings of these offerings: a meal was to have at least 200 calories and 10 grams of dietary protein; and, any shake needed to contain at least 200 kcal and 20 grams of protein. A protein powder, used to enhance the protein content of any food or beverage, should contain at least 5 grams of dietary protein. All offerings needed to be easy-to-prepare.

No attempt was made to enrich the special food offerings with dietary fiber, vitamins, or minerals. These potentially could worsen the flavor profile, and all are readily obtained from other foods or supplements. As these specially-formulated food offerings are designed to be consumed over a short period of time during cancer treatment, there was less emphasis on restricting saturated fat and sodium. A single serving of meal or shake could be considered to be one of three meals, so the goal was not exceed one-third of the Daily Value of saturated fat and sodium.

The specially-tailored food offerings were tested in the same cohort of ten head and neck cancer patients, studied previously [11-13]. The data collected during treatment were defined as the acute treatment group ($n = 6$), and the data collected after treatment were defined as the post-treatment group ($n = 8$; four patients were evaluated during and after treatment, four patients were evaluated after treatment only and two patients were included during treatment) [13]. During a cancer treatment, patients were provided their choice of four single-servings of the meals (i.e., vegetarian, beef and mushrooms, and chicken and dumpling) and two shake flavors (chocolate and

vanilla) for trial at home. After the use of each product, patients were asked to complete a paper product evaluation form assessing their experience and preference.

Half the participants reported having a poor appetite [13]. Despite this, the subjects were able to complete 75% of a single serving of the tailored food offerings. More than 70% of these were rated favorably and there were no reports of having an after-taste or burning sensation while consuming the food offerings. Taste changes were more pronounced in those in the active phase of treatment (60% with moderate to severe changes) compared to those after treatment (50% no taste change and no severe taste loss).

The research conducted by the CNC prompted this current study. It is clear that patients undergoing cancer treatments feel fatigued, have food aversion leading to reduced food intake, and most experience weight loss. The purpose of this pilot study was to characterize patients undergoing cancer treatment who may benefit from portion-controlled offerings, tailored to their needs. Cancer patients undergoing treatment received the offerings at no charge in exchange for completing a survey about themselves and how they liked the food offerings. The findings may help healthcare practitioners identify which patients undergoing cancer treatment would benefit from these special food offerings.

METHODS

The study is a prospective, single-armed survey pilot study that included patients undergoing cancer treatments who visited the Cancer Nutrition Consortium (CNC) website (<https://www.cancernutrition.org>). A subset of these patients opted to receive at no charge single servings of tailored food offerings designed to meet the nutritional needs during cancer treatment. The offerings were provided to the participants by Hormel Health Labs, a division of Hormel Foods Corporation (<https://www.hormelhealthlabs.com/>). Hormel Foods is a sponsor of the Cancer Nutrition Consortium (<https://www.hormelfoods.com/>). The study was conducted between February, 2019 and January, 2021.



Participants

Any type of cancer patients were included in the survey as long as they were actively undergoing treatment or had recently completed it. Treatments mostly included chemotherapy, radiotherapy, surgery, or any combination of these.

Portioned-controlled, tailored food offerings

The CNC approached several food companies to create food offerings in accordance with established guidelines based on the scientific studies (add all studies). Hormel Health Labs, which is a division of Hormel Foods Corporation, was selected to make meals, shakes, and a protein powder supplement.

Each participant was sent single servings of: three meals (one each of Beef and mushrooms; Chicken and dumplings; and Vegetarian stew, with chickpeas providing most of the dietary protein); four shakes (two each of Chocolate and Vanilla), five packets of a protein powder, and a shaker bottle (Table 1). The meals required about one minute to heat in a microwave oven. The shakes are ready to use, and protein powder was added to the entrees, shakes, or any other food or beverages. The home shipment of these items was subsequently referred to as a Nutrition Carepack. The Carepack is sold under the Vital Cuisine® line, with a retail price is \$55.00. Hormel Health Labs generously donated the Nutrition Carepacks to the CNC to distribute to any cancer patient undergoing treatment, who requested the foods in exchange for providing information about them to the CNC.

Survey questionnaire

Survey questions included: the type of cancer; treatment; changes in body weight, appetite, taste aversions; and details about each product (e.g., texture, flavor, odor, ability to consume the entire serving, a feeling of being pleasantly full, side effects). For questions related to the Nutrition Carepack products, a grading system of 1 to 5 was used with 1 being the worst and 5 being the best.

Surveys were mailed separately to the participants on the same day that the Nutrition Carepacks were shipped. Each participant granted consent on the survey form. If the survey was returned within 60 days, the participants were given a \$5 Amazon eGift Card.

Data were presented as means \pm standard deviation.

RESULTS

One hundred thirty-seven patients undergoing cancer treatment requested the Nutrition Carepack. Of these, most were female (79%), and they resided in 38 of the 50 United States, representing all around the country. Six or fewer people requested the Nutrition Carepacks from 33 of these 38 states. The five states with the highest requests were from: Florida (n=12), Ohio (n=11), Michigan (n=10), and Pennsylvania and New York (n=9 from each state).

Twelve of the 137 patients requesting the Nutrition Carepacks did not complete the survey (91% response rate). These remaining 125 subjects, who completed the survey, had a mean age of 56 ± 14 years (range from 19 to 89 years). Weight loss was reported by 53% and the rest said they did not have weight loss (38%) or were unsure (10%).

Cancer-related data

Participants reported having 22 types of cancer with most having breast cancer (45%), followed by cancer of the reproductive system (12%), throat or lung cancer (9%), lymphoma or colorectal cancer (7%), and leukemia (4%). Other forms of cancer were less common and occurred in fewer than six participants. The stage of cancer was fairly evenly distributed for the group: stage 1, 29%; stage 2, 17%; stage 3, 29%; and stage 4, 24%.

The participants received one or more cancer treatments: 82% had chemotherapy; 57% had radiation therapy, 57% had surgery, 4% had a bone marrow transplant, and 21% reported having other therapies (e.g., blood transfusion, hormonal- and immuno-therapy, and vitamin supplements). Nearly half the participants (43%) had two different treatments (i.e., chemotherapy plus

radiation therapy; chemotherapy plus surgery; or radiation therapy and surgery). In addition, 27% had three treatments (i.e., chemotherapy, radiation therapy, and surgery).

Most participants reported that they were currently undergoing treatment (87%), followed by 10%, who reported having completed their treatment within the past six months. The other 3% completed their treatments beyond six months.

Changes in the ability to eat

The most common changes related to eating were: a decreasing appetite (69%), having a dry mouth (74%), and experiencing changes in food flavors and aversion (74%). The most common food aversions were for sweet, salty, or spicy foods; meat and fish; greasy food; fast food; vegetables; and solid foods. In contrast, only 35% reported having difficulty swallowing.

Nutrition Carepack

Nearly all participants found that the Nutrition care pack was a valuable asset to their nutrition (96%). The meals and shakes were in compliance with the recommendation set by the CNC. A single serving of the meals provided between 300 and 350 calories and 11 to 23 grams of dietary protein, which represents 20% to 42% Daily Value for protein, respectively (Table 1). A serving of a shake provided 520 calories and 22 grams of dietary protein (44% Daily Value for protein). A serving of the protein powder contained 35 calories and 6 grams of dietary protein (12% Daily Value for protein) (one packet = 8 grams).

Flavor, texture, odor

The offerings in the Nutrition Care pack were rated for flavor, texture, and odor, using a rating scale of 1 (worst) to 5 (best) (Table 2). No mean score for any attribute was lower than 3.50. The highest rated offerings were the two shakes with means for both shake for all attributes exceeding 4.0. The Vanilla and Chocolate shakes were comparable for flavor, texture, and odor.

The meals of Beef and mushrooms and Chicken and dumplings were rated highly with the Beef being a little better than the Chicken for each attribute (Table 2). The rating for Beef for flavor was $4.05 \pm$ ad similar ratings of flavor, 3.98 ± 1.04 ; texture, 3.78 ± 1.02 ; and odor 3.78 ± 1.04 .

The lowest rated Nutrition Carepack offering was the Protein powder (flavor, 3.63 ± 1.31 ; texture, 3.65 ± 1.24 ; and odor 3.76 ± 1.26) (Table 2). The lowest rated meal was for the Vegetarian stew for each attribute (flavor, 3.69 ± 1.18 ; texture, 3.62 ± 1.21 ; and odor 3.55 ± 1.24).

Ability to consume entire single serving Nutrition Carepack offerings

A higher percentage of participants were able to finish an entire serving of all Nutrition Care pack offerings compared to those eating only part of the offerings (Table 3). More than half of the participants were able to consume the entire amount for both of shake offerings (66% for the Chocolate; 64% for the Vanilla). Another substantial percentage of the group was able to consume at least three-quarters of both shakes (Chocolate 18%; Vanilla 19%). Thus, a sizable percentage of the participants were able to consume at least three-quarters of the shake offerings (Chocolate, 84%; Vanilla, 83%). Only 9% of the group was unable to consume at least one-quarter of either shake. More than half of the participants consumed all the Protein powder (54%), while 15% did not use at least one-quarter of it.

Nearly half of the participants were able to consume the entire single serving of each of the three meals (48% for Beef; 52% for Chicken; and 47% for the Vegetarian stew) (Table 3). Most subjects consumed at least three-quarters of each meal (74% for Beef; 78% for Chicken; and 79% for the Vegetarian stew). Only a small percentage of the subjects were unable to eat at least one-quarter of the meal offerings (10% for Beef; 9% for Chicken; and 12% for the Vegetarian stew).

Feeling of being pleasantly full after consuming a single serving of a Nutrition Carepack offering



More than half of the group felt pleasantly full after drinking the Chocolate (58% of participants) and Vanilla shakes (57%) (Table 4). Similarly, at least half of the participants stated they felt full after consuming the Beef and mushroom and Chicken and dumpling meals (55% of the group stated they felt full for each meal). Fewer reported that the Vegetarian stew offered a sense of fullness (45%) and 18% reported that they did not feel full at all. This lack of satiety was not echoed in the other products with only 12% of the group reporting the lack of fullness for both Shakes and 10% for the Beef and Chicken meals.

As expected, due to its low energy content, the Protein powder did not promote satiety and only 39% reported they felt full after consuming it (Table 4). Twenty-one percent of participants reported not feeling full after its use.

Stomach side effects after consuming the Nutrition Carepack offerings

Reports of any gastric side effect after consumption of any Nutrition Carepack offering was small; fewer than 4% of participants reported stomach-related issues (Table 5). In contrast, a very high percentage reported no stomach-related issues after eating the offerings. Eighty-eight percent of the group reported no gastric side effects after taking the Chicken and dumplings meal and the Vanilla shake. A similar percentage (85%) reported no side effects after consuming the Beef and mushroom meal, the Chocolate shake, and the Protein powder. After eating the Vegetarian stew, 82% reported no stomach-related issues.

DISCUSSION

Patients undergoing cancer treatment are not typically provided dietary counseling, but many would benefit from it. Based on studies from the Cancer Nutrition Consortium, side effects of cancer treatment like fatigue and food aversions are common and lead to weight loss [9-13]. Portion-controlled, easy-to-prepare food offerings tailored to the needs of cancer patients undergoing treatment can combat these side effects. From this study's

survey, nearly all cancer patients requesting the Nutrition Carepack, containing these specialized foods, claimed that they were valuable.

The highest rated food offerings for flavor, texture, and odor were the Vanilla and Chocolate shakes with mean ratings of each in excess of 4.0 with 5.0 being the best. This was closely followed by two meals – Beef and mushrooms and Chicken and dumplings. The Shakes had more calories per serving than the Meals (520 kcal vs. less than 350 kcal), but most of the participants were able to eat at least three-quarters of both the Shakes and Meals. The Shakes may be the best way to get the most calories in a single serving. As dietary protein content was comparable between the Shakes and the two Meals, all seem to be excellent food options for patients undergoing cancer treatment.

More than 80% of the participants reported no gastric-related side effects from any offering of the Nutrition Carepack. Fewer than 4% of the entire group experienced any gastric-related side effects from consuming any offering in the Nutrition Carepack. This provides some evidence that the ingredients assembled to make the foods were acceptable to a broad range of cancer patients undergoing treatment.

The offering in the Nutrition Carepack met the criteria based on nutritional research studies conducted by the Cancer Nutrition Consortium (CNC), an organization that conducts research on patients undergoing cancer treatment [9-13]. The findings from the research studies identified the main side effects of treatment that impact nutrition are fatigue and food aversions. These participants were unable to consume adequate energy and dietary protein, and single serving offerings were developed based these findings. Based on the survey responses, the participants stated that the meals seemed to be the right size (most were able to finish a single serving), were well accepted (flavor, texture, and odor scores were favorably rated), and side effects were nearly non-existent.

The Nutrition Carepack food offerings evaluated herein are designed to be used during active treatment, which is admittedly short-term (i.e., months rather than years). Others have proposed dietary plans that address the

longer, post-treatment phase such as the Mediterranean diet [14, 15]. Others dietary regimens such as a ketogenic diet and caloric restriction have been proposed for both prevention and treatment [16, 17].

Based on meta-analyses of more than 2 million subjects, following a Mediterranean diet after cancer occurs, results in a decrease in mortality of 20-60% depending upon the type of cancer [14]. Patients with colorectal, breast, liver, gastric, and head and neck cancers experienced the most benefit. The aspects of the Mediterranean diet that offered protection were attributed to the high intake of fruits, vegetables, and whole grains. A later study in patients with colorectal cancer echoed these findings [15]. While not following a Mediterranean diet specifically, colorectal cancer patients experienced less fatigue and had better physical functioning by increasing the consumption of dietary fiber, fruits, and vegetables. The Nutrition Carepack food offerings are not rich sources of these components, so the Mediterranean diet or a diet rich in fiber, fruit, and vegetables, seems like a good next step after the active treatment phase has been completed.

Others have proposed adopting a ketogenic diet for both cancer prevention and treatment [16]. This type of diet includes ample protein, while being high in fat and low in carbohydrate. The ketogenic diet creates an unfavorable environment for cancer cells to replicate. Based on a review of 57 clinical studies, a ketogenic diet was shown to slow tumor growth, prolong survival rate of the host, delay the initiation of new tumors, and reverse cancer cachexia. The offerings found in the Nutrition Carepack are not ketogenic, but based on these benefits, a ketogenic may be another option for cancer patients to adopt after active treatment has been completed.

Various versions of calorically-restricted diets have shown promise for cancer prevention and treatment. This may seem paradoxical as most clinicians recommend a high calorie diet while patients are undergoing cancer treatment. Caloric restriction, defined as a reduction of 20% to 40% of daily energy needs, has shown to augment cancer therapies and prevent future malignancies [17]. Despite these benefits and having no side effects, adoption of such a

regimen has proven difficult because it induces hunger. Instead of frank calorie restriction, other, less onerous versions have been proposed such as periodic fasting and fasting-mimicking diets. Although no randomized clinical trials are available on any form of a calorically-restricted diet, preclinical and laboratory studies support a role for them. Energy restriction offers a protective environment for normal cells, while creating a metabolic environment that does not favor pre-cancerous or cancer cells. The offering in the Nutrition Carepack do not embrace the concept of calorie restriction, but given the promising findings so far, after active cancer treatment is complete, patients may want to follow this approach.

The major strengths of this study is that it supports the benefits of portion controlled, specially-tailored foods that are based on clinical studies and are available today for patients undergoing cancer treatment [9-13]. The limitation of this study is that in the future, with the advent of precision nutrition, these nutritional offerings may not be appropriate for all cancer patients [18]. The new area of precision nutrition takes into consideration the type of cancer, its location, molecular and histological characteristics, and the unique metabolic requirements of the tumor. Dietary nutrients affect different types of cancer differently, resulting in the need to create dietary recommendations on a case-by-case basis. The concept that dietary changes could improve the response to cancer therapy is extremely attractive to many patients, and compliance with a personalized dietary regimen will likely be high. There is still much to be learned about precision nutrition, but the future lies in understanding of how diet can interface with the complex interactions among the type of cancer, the microenvironment, systemic metabolism, and treatments. The intent is to allow clinicians to offer patients rational advice on nutritional intake that will maximize the effect of their therapy.

CONCLUSIONS



Cancer patients undergoing treatment are in need of specialized foods to provide nutrition because many experience fatigue and food aversion, which leads to weight loss. Food offerings were designed based on the unique needs of these patients. A survey of cancer patients undergoing treatment revealed widespread acceptance of single serving, easy-to-prepare meals, shakes, and a protein supplement. Healthcare professionals should be aware of the side effects that occur during cancer treatment and that can lead to poor nutritional intake and weight loss. The offerings found in the Nutrition Carepack may be of help to patients undergoing cancer treatment in that they are easy-to-prepare, have virtually no side effects, and are widely accepted.

REFERENCES

1. Cancer statistics. National Cancer Institute. Accessed 5/40/21. <https://www.cancer.gov/about-cancer/understanding/statistics>
2. Rock CL, Thomson C, Gansler T, Gapstur SM, McCullough ML, Patel AV, Andrews KS, Bandera EV, Spees CK, Robien K, Hartman S, Sullivan K, Grant BL, Hamilton KK, Kushi LH, Caan BJ, Kibbe D, Black JD, Wiedt TL, McMahon C, Sloan K, Doyle C. American Cancer Society guideline for diet and physical activity for cancer prevention. *CA Cancer J Clin.* 2020 Jul;70(4):245-271. doi: 10.3322/caac.21591. Epub 2020 Jun 9.
3. Donaldson, M.S. Nutrition and cancer: A review of the evidence for an anti-cancer diet. *Nutr J*, 19 (2004).
4. Kyrgiou M, Kalliala I, Markozannes G, Gunter MJ, Paraskavidis E, Gabra H et al. Adiposity and cancer at major anatomical sites: umbrella review of the literature *BMJ* 2017; 356 :j477.
5. Adult obesity facts. Accessed 5/30/21. <https://www.cdc.gov/obesity/data/adult.html>
6. Ravasco P. Nutrition in Cancer Patients. *J Clin Med.* 2019 Aug 14;8(8):1211.
7. Understanding chemotherapy. Cancer.net editorial board, 5/2019. <https://www.cancer.net/navigating-cancer-care/how-cancer-treated/chemotherapy/understanding-chemotherapy>
8. National Cancer Institute. Radiation therapy and you: Support for people with cancer. Accessed 5/30/21. <https://www.cancer.gov/publications/patient-education/radiationtherapy.pdf>
9. Coa KI, Epstein JB, Ettinger D, Jatoi A, McManus K, Platek ME, Price W, Stewart M, Teknos TN, Moskowitz B. The impact of cancer treatment on the diets and food preferences of patients receiving outpatient treatment. *Nutr Cancer.* 2015;67(2):339-53. doi: 10.1080/01635581.2015.990577. Epub 2015 Feb 9.
10. Coa K, Epstein JB, McManus K, Moskowitz B. Dietary changes and food preferences experienced by older adult cancer patients and the impact on health outcomes. *Curr Res Nutr Food Sci.* 2018; 6(2):263-272.
11. Epstein, J.B., Villines, D., Epstein, G.L. et al. Oral examination findings, taste and smell testing during and following head and neck cancer therapy. *Support Care Cancer* 28, 4305–4311 (2020).
12. Epstein JB, Dana Villines MA, Geena L. Epstein RN, Smutzer G (2020) Patient Reported Outcomes, Oral Health, Taste and Dietary Impact During and Following Head and Neck Cancer Therapy. *J Cancer Biol Res* 8(1): 1128.
13. Epstein JB, Villines D, Epstein DL, Rawal S, et al. Assessment of Oral Function and Food Product Preference in Patients with Head and Neck Cancers. *Clin Oncology Res.* 2020.
14. Schwingshackl L, Schwedhelm C, Galbete C, Hoffmann G. Adherence to Mediterranean Diet and Risk of Cancer: An Updated Systematic Review and Meta-Analysis. *Nutrients.* 2017;9(10):1063.
15. Kenkhuis M-F, van Duijnhoven FJB, van Roekel EH, et al. Longitudinal associations of fiber, vegetable, and fruit intake with quality of life and fatigue in colorectal cancer survivors up to 24 months post-treatment, *The American Journal of Clinical Nutrition*, 2021;, nqab360.



16. Weber DD, Aminzadeh-Gohari S, Tulipan J, Catalano L, Feichtinger RG, Kofler B. Ketogenic diet in the treatment of cancer - Where do we stand? *Mol Metab.* 2020 Mar; 33:102-121.
17. Brandhorst S, Longo VD. Fasting and Caloric Restriction in Cancer Prevention and Treatment. *Recent Results Cancer Res.* 2016;207:241-66. doi: 10.1007/978-3-319-42118-6_12.
18. Tajan M, Vousden KH. Dietary Approaches to Cancer Therapy. *Cancer Cell.* 2020 Jun 8;37(6):767-785. doi: 10.1016/j.ccell.2020.04.005. Epub 2020 May 14.

PEER REVIEW

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TABLES

Table 1. Nutritional composition of selected nutrients of portion-controlled offerings from the Nutrition Carepack (per serving)*.

Nutritional information+	Meal: Beef and mushrooms (1 tray = 213 g)	Meal: Chicken and dumplings (1 tray = 213 g)	Meal: Vegetarian stew (1 tray = 213 g)	Shakes: -Chocolate -Vanilla (1 container of each = 8.45 ounces)
Calories	350	300	330	-520 -520
Fat (g)	22 (28)	16 (25)	17 (22)	-21 (27) -22 (28)
Saturated fat (g)	7 (35)	5 (25)	3 (13)	-3 (15) -4 (18)
Sodium (mg)	580 (25)	590 (25)	670 (29)	-380 (17) -410 (18)
Carbohydrate (g)	21 (8)	17 (6)	32 (12)	-60 (22) -59 (21)
Fiber (g)	3 (11)	2 (8)	5 (18)	-0 -0
Protein (g)	16 (30)	23 (42)	11 (20)	-22 (44)



				-22 (44)
<i>Other nutrients naturally-occurring in excess of 20% Daily Value</i>	-Vitamin B12 -Phosphorus	None	-Vitamin A -Vitamin B12	-Calcium for both flavors -For chocolate: vitamin K, phosphorus, zinc

*Nutritional information for the protein powder is not presented in the table above. It has 35 calories and 6 grams of dietary protein (12% Daily Value) (one packet = 8 grams).

+Presented as the amount in a single serving of the product and the percent Daily Value are in parentheses

Table 2. Nutrition Carepackoffering ratings for flavor, texture, and odor*.

Product	Flavor	Texture	Odor
<i>Meals</i>			
Beef and mushrooms	4.05 ± 1.04	3.91 ± 1.07	3.93 ± 1.10
Chicken and dumplings	3.89 ± 1.04	3.78 ± 1.02	3.78 ± 1.04
Vegetarian stew (chickpeas provide most of the dietary protein)	3.69 ± 1.18	3.62 ± 1.21	3.55 ± 1.24
<i>Shakes</i>			
Chocolate	4.21 ± 1.13	4.12 ± 1.09	4.26 ± 1.10
Vanilla	4.04 ± 1.21	4.08 ± 1.13	4.18 ± 1.06
<i>Protein supplement</i>			
Powder	3.63 ± 1.31	3.65 ± 1.24	3.76 ± 1.26

*Ratings were between 1 (worst) and 5 (best)

Table 3. Amount consumed for a single serving of each item in the Nutrition Carepack (percentage of participants able to consume each amount of a food offering).

Product	0% amount consumed	25% amount consumed	50% amount consumed	75% amount consumed	100% amount consumed
<i>Meals</i>					
Beef and mushrooms	2%	8%	16%	26%	48%
Chicken and dumplings	2%	7%	13%	26%	52%
Vegetarian stew	3%	9%	16%	23%	47%
<i>Shakes</i>					
Chocolate	3%	6%	7%	18%	66%
Vanilla	4%	5%	9%	19%	64%
<i>Protein supplement</i>					
Powder	5%	10%	13%	17%	54%

Table 4. Degree of feeling pleasantly full after completing a single serving of an offering from the Nutrition Carepack (percentage of participants).

Product	Full pleasantly feeling (percentage of participants)	Somewhat full feeling (percentage of participants)	Not feeling full (percentage of participants)
<i>Meals</i>			
Beef and mushrooms	55%	34%	10%
Chicken and dumplings	55%	35%	10%
Vegetarian stew	45%	37%	18%
<i>Shakes</i>			
Chocolate	58%	30%	12%
Vanilla	57%	31%	12%

<i>Protein supplement</i>			
Powder	39%	39%	21%

Table 5. Stomach side effects in response to eating the offerings from the Nutrition Carepack.

Product	None (no stomach-related side effects)	Some (some stomach-related side effects)	A lot (many stomach-related side effects)
<i>Meals</i>			
Beef and mushrooms	85%	14%	2%
Chicken and dumplings	88%	11%	2%
Vegetarian stew	82%	14%	2%
<i>Shakes</i>			
Chocolate	85%	13%	3%
Vanilla	88%	10%	2%
<i>Protein supplement</i>			
Powder	85%	13%	2%