FOOD AND NUTRITION IN COLLECTIVE HEALTH
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This study originates from the master's thesis titled "Adaptation and Experimentation of Culinary Recipes of the Nutrition and Cooking in the Kitchen Program for People with Type 2 Diabetes," authored by Camila Vieira Tiecher and supervised by Ana Carolina Fernandes. It was conducted under the Graduate Program in Nutrition at the Federal University of Santa Catarina and was presented in August 2019 in Florianópolis, SC, Brazil.

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Culinary recipes adaptation to a cooking skills intervention program for individuals with type 2 diabetes: a feasibility study

Adaptação de receitas culinárias de um programa de intervenção em habilidades culinárias para indivíduos com diabetes tipo 2: um estudo de viabilidade.

Abstract

Introduction: Healthy eating habits and cooking skills can contribute to the treatment of type 2 diabetes mellitus (T2DM). ***Objective***: This study aimed to adapt, test, and qualitatively evaluate the sensory characteristics of food recipes for their application in a culinary intervention program for individuals with type 2 diabetes, called Nutrition and Culinary in the Kitchen. ***Methods***: Nutrition and Culinary in the Kitchen is an intervention program with hands-on cooking classes focused on promoting cooking skills. Recipes' modifications were based on the glycemic index of ingredients, then tested and discussed by nutrition experts in consensus workshops. Individuals with type 2 diabetes assessed and discussed the sensory characteristics of recipes in focus groups. ***Results***: Recipes adaptations to suit type 2 diabetes population included replacement of rice by cauliflower and pasta by zucchini, and the use of fruits and spices in sweet recipes instead of using added sugar ingredients and/or non-caloric sweeteners. Those changes were positively accepted by the individuals with type 2 diabetes. ***Conclusion***: The adapted culinary recipes can be used in dietary guidelines and in cooking interventions to promote eating habits that contribute to glycemic control.

Keywords: Culinary skills. Cooking recipe. Health intervention. Recipe development. Diabetes

Resumo

Introdução: Hábitos alimentares saudáveis e habilidades culinárias podem contribuir no tratamento de diabetes *mellitus* tipo 2.***Objetivo***: Este estudo visou adaptar nutricionalmente, testar e avaliar qualitativamente as características sensoriais de receitas culinárias para sua aplicação em um programa de intervenção culinária para indivíduos com diabetes tipo 2, denominado Nutrição e Culinária na Cozinha. ***Método***:O programa Nutrição e Culinária na Cozinha é uma intervenção com oficinas culinárias práticas focadas na promoção das habilidades culinárias. As modificações das receitas foram baseadas no índice glicêmico dos ingredientes, depois testadas e discutidas por especialistas em nutrição por meio de oficinas de consenso. Realizaram-se grupos focais com indivíduos com diabetes tipo 2 para avaliar e discutir as características sensoriais das receitas culinárias. ***Resultados***: As adaptações das receitas para atender à população com diabetes tipo 2 incluíram a substituição de arroz por couve-flor e macarrão por abobrinha, além do uso de frutas e especiarias em receitas doces em substituição a ingredientes com açúcares de adição e/ou edulcorantes Essas mudanças foram aprovadas pelos indivíduos com diabetes tipo 2.***Conclusão***: As receitas culinárias adaptadas poderão ser utilizadas em

orientações dietéticas e em intervenções culinárias para promover hábitos alimentares que contribuam para o controle glicêmico.

Palavras-chave:Habilidades culinárias. Receita culinária. Pesquisa qualitativa. Desenvolvimento de receitas. Diabetes.

INTRODUCTION

Chronic noncommunicable diseases are a leading cause of death worldwide, particularly diabetes, cancer, cardiovascular diseases, and respiratory diseases.[1] More than half of the deaths from diabetes mellitus in Central and South America occur in Brazil,[2] where the prevalence of diabetes increased from 6.3% in 2009 to 9,1% in 2021.[3,4]

About 90% of all diabetes mellitus cases are classified as type 2 (T2DM),[2]characterized by a variety of metabolic disorders, including persistent hyperglycemia, due to a relative (but not absolute) deficiency in insulin production or in its action, or in both mechanisms and peripheral insulin resistance.[2,5,6]In Brazil, T2DM is associated with high hospitalization rates resulting from disease complications.[6] For glycemic stability and prevention of health complications, national and international diabetes guidelines recommend the adoption of a healthy diet rich in complex carbohydrates with a high fiber content (14- 50 g/1,000 kcal) and limited in sodium and saturated fat; following these recommendations is a form of exercising autonomy and self-care.[5-7]

Scientific research and some diabetes guidelines suggest that the consumption of low glycemic index (GI) foods,[6-10] low-carb diets,[5,11,12] and ketogenic diets[11,12] can improve glycemic stability in people with T2DM. However, previous studies showed that these individuals have difficulty engaging to diets recommended by diabetes guidelines[13,14] and, as such, difficulty to include healthy foods to diet.[14-16]

A systematic review found that the preparation and consumption of meals at home is a potential strategy to prevent and manage T2DM.[17]In this context, intervention studies on cooking skills (hands-on cooking classes) conducted in Australia,[18] the United Kingdom,[19] and England[20] reported associations between improvement of cooking skills and healthier eating behaviors in adults. Cooking interventions performed with individuals with T2DM had a positive impact on glycemic stability and stimulated the adoption of healthy eating practices.[21-25] However, none of these studies have clarified methodological approaches used to deliver those culinary interventions with T2DM groups, such as which culinary recipes were used, which criteria were adopted to select the recipes or whether the recipes were previously tested for technical criteria, and sensorially approved by the target audience.

In Brazil, to the best of our knowledge, only one intervention program withhands-on cooking classesfocused on promoting cooking skills has been carried out, called the Nutrition and Culinary in the Kitchen (NCK) program,[26,27]culturally adapted based on the US American program Cooking with a Chef.[28]The NCK was aimed at a healthy population of university students and included five stages, being the first the development and adaptation of culinary recipes for later application in workshops with the target population.[29] The intervention using the NCK program hadan immediate and sustained effect by improving cooking skills and increasing the availability of fruits and vegetables at home.[26,27] Since it has produced positive outcomes for healthy adults, authors suggested adapting the NCK program for other population groups.[26,27]

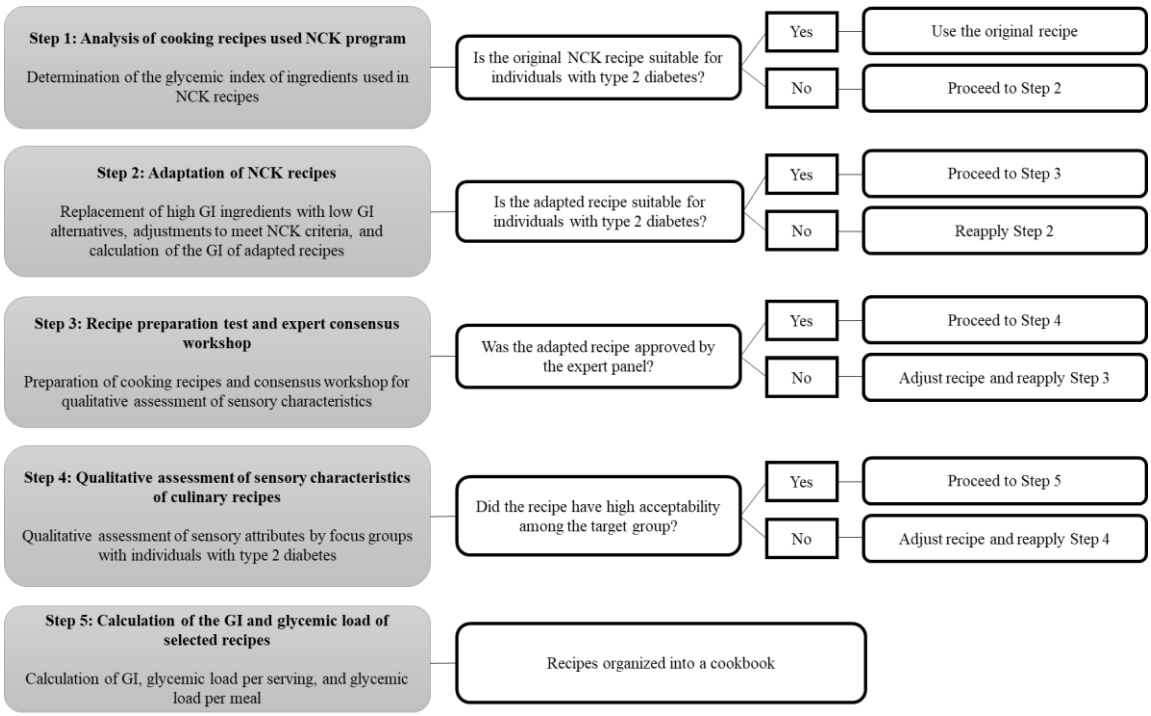
Thus, this study aimed to adapt, test, and qualitatively evaluate the sensory characteristics of NCK culinary recipes for their application in an intervention focused on the development of cooking skills in individuals with T2DM.

METHODS

Study design and procedures

This is a feasibility study[30] developed in a master's thesis, with qualitative and quantitative procedures, carried out for the adaptation of culinary recipes from the Brazilian intervention program NCK[26] to be applied latter in intervention on cooking skills for individuals with T2DM, as shown in Figure 1.

Figure. 1. Procedure for adapting and testing culinary recipes from the Nutrition and Culinary in the Kitchen program for use by individuals with type 2 diabetes.



Qualitative steps included the selection of criteria for recipe adaptation, adequacy test of culinary recipes through consensus workshops with nutrition experts, and qualitative assessment of the sensory characteristics of culinary recipes by individuals with T2DM. The quantitative step was the calculation of the GI and glycemic load (GL) of culinary recipes.

The main outcomes of this research are: a) identification of ingredients that meet NCK criteria and have low GI to substitute those with medium or high GI; b) adequacy and approval of the technical aspects and sensory attributes of the recipes by experts; c) opinion and approval of the target audience regarding the sensory characteristics of recipes developed for them; d) calculation of GI and GL values of adapted culinary recipes and all recipes of each NCK cooking class.

Evaluation and adaptation of NCK culinary recipes

The culinary recipes analyzed in this study were developed for the NCK program[26,27] and were translated, tested, and adapted by Rita *et al*.[29] from culinary recipes proposed by the Cooking With a Chef programin the United States of America.[28,31]

The first step of this study was the classification of the ingredients of each NCK culinary recipe (*n* = 32) according to their GI into low (≤55), medium (56 to 69), or high (≥70). Classification of GI was based on the Brazilian Table of Food Composition[32] and proposed by Foster-Powell *et al*.[33] and Atkinson *et at*.[34]Culinary recipes that had only low GI ingredients were not modified, whereas those with medium or high GI ingredients were adapted according to the needs of people living with T2DM.

In sequence, the cooking recipes adaptation was carried out byreplacing ingredients with medium or high GI by similar ingredients with low GI (e.g., mango was replaced by avocado). In the case that recipes had to be completely modified, the following criteria (in accordance with principles from the NCK) were applied for the selection of new recipes: conformity with the objectives and duration of each cooking class; low cost (used just as precondition of the NCK for ingredient selection, not to a cost analysis); use of accessible utensils; and compliance with healthy eating recommendations[35] (preference for fresh and minimally processed foods, limited use of salt and sugar, use of herbs and spices, use of healthy preparation techniques, use of seasonal vegetables, regional foods, and elimination of ultra-processed foods and ingredients with industrial trans fatty acids).

Specific dietary recommendations for T2DM were then considered, such as preference for sources of complex carbohydrates with high fiber contents and no use of added sugars or intense sweeteners.[6] As for recipes involving sugar, such as the whole-grain oatmeal fruit cake, sugar was completely removed without adding intense sweeteners. High-glycemic fruits used were replaced by low glycemic fruits, herbs and spices.

Food preparation and adequacy tests by nutrition experts

Food preparation and adequacy tests for sensory attributes and technical aspects were conducted at the Laboratory of Dietetic Technique of the university where the study was conducted. The culinary recipes were prepared by members of the research group, among them students of the master's or undergraduate degree in Nutrition.

The sensory attributes of culinary recipes were assessed in a consensus workshop.[36] A standardized form adapted from Rita *et al*.,[29] including the name of the adapted recipes, sensory attributes (appearance, color, aroma, texture and flavor), and comments were provided at this stage to assist in the discussion. In this form, the specialists classified each sensory attribute either as "adequate" or "inadequate" and wrote suggestions for improvements in cooking techniques to achieve sensory adequacy, when necessary.

The expert committee was composed of a convenience sample of 11 dietitians with experience in cooking and/or outpatient care of individuals with T2DM, who were also researchers in the institution where the study was conducted. The committee assessed the technical aspects of the adapted culinary recipes, as well as suggested changes considering the use of low glycemic index ingredients, by tasting the recipes, filling the sensory attribute form for each recipe, and discussing the results until consensus.

Qualitative assessment of culinary recipes by individuals with T2DM

In this step, a qualitative method was used to analyze the opinion of our target audience regarding the sensory characteristics of recipes developed for them, since we needed information to understand why some sensory attribute was not suitable and how we could improve it for this audience. The tested culinary recipes were also prepared by members of the research group, but tasted and sensory evaluated by the target audience, seeking information from people who experience diabetes in their daily routine. Since this study

aimed to develop culinary recipes well accepted by the target audience, we opted to carry out focus groups after tasting the recipes to obtain an in-depth evaluation of the culinary recipes, and not a cut-off score like in quantitative studies.

The sensory attributes of adapted culinary recipes were qualitatively evaluated in focus groups, following the recommendations of Sofaer[37] and Krueger and Casey.[38] A convenience sample of participants were recruited through online advertisements with a link to a registration form. Volunteers with T2DM were invited to participate to the stage related to the qualitative assessment of culinary recipes. Thus, eligible volunteers could be contacted by the research team. The inclusion criteria were as follows: individuals with self-reported diabetes mellitus type 2 (diagnosed by health professionals), aged more than or equal to 20 years and less than 70 years, who were able to understand and speak Portuguese, and accepted to participate in the study. We adopted self-reported diabetes as an inclusion criterion because it is simple to collect, it is low cost and, as some studies have already shown, it is valid data.[39,40] Individuals diagnosed with kidney disease, cancer, celiac disease, food allergies or intolerances, as well as people who reported difficulties in chewing, swallowing, or other alterations that could impair sensory perception, were excluded from the study.

Adapted recipes were organized into three complete meals(one appetizer, one main course, two hot side dishes and one dessert), just for thetest, and each meal was assessed by a focus group, totaling three focus groups. Participants could attend different sessions, depending on their availability. Each session was scheduled after confirming the participation of a convenience sample composed of at least 5 to up to 10 people[37,38] of both genders.

Participants were given an evaluation form adapted from Rita *et al.*[29]to record sensory attributes (appearance, color, aroma, texture, and taste) and space for comments. This form served as a support tool for data collection and made it easier for participants to present their perceptions, whether the preparation was adequate or not and suggestions for improvement of the recipes in focus group discussions.

At the beginning of each session, a moderator explained to the participants the study objectives, how the activity would be conducted, and how the data would be analyzed to ensure anonymity. Focus groups were guided by a single open question for each food preparation: “What do you think about this culinary recipe?”. Discussions were concluded when the participants had finishedcommenting on each recipe. Focus group discussions were recorded and transcribed by the moderator, and notes were taken by an observer.

Food tastings took place during focus group sessions, at 12 am., the usual lunch time in Brazil. With respect to other meals, participants were asked to follow their normal eating routines. Foods were served in the following order: starters, main course with side dishes, and dessert. Each recipe was served individually, and participants could help themselves freely. Participants were instructed to taste the foods separately and then in combination, as they would normally consume (e.g., cauliflower with beans, similar to the well popular “rice and beans” dish in Brazil) and this was discussed during the focus groups. Thus, the approval included the discussion and reporting the potential acceptability of the replacement.

Sociodemographic variables (gender, age, and time since T2DM diagnosis) were analyzed by descriptive statistics. Transcribed texts from focus group discussions were analyzed by structured thematic analysis[38,41] with a priori categorization. Comments on each culinary recipe were divided into two categories: i) positive comments and opinions and ii) negative comments and suggestions for improvement. Recipes were considered approved by the target audience when all participants reached consensus on acceptance, or no suggestions were made that would imply the need for retesting.

After approval, recipes were organized into a cookbook containing information on ingredients, low GI substitutes for individuals with T2DM, cooking utensils, preparation time, household measures, and preparation techniques. This material that brought together the adapted culinary recipes enabled the subsequent study that carried out and evaluated the impact of a cooking intervention on the cooking skills of individuals with type 2 diabetes.

Estimation of the GI and GL of adapted culinary recipes and meals ineach NCK cooking class

The calculation of the GI and GL of culinary recipes was only carried out after approval by the target audience. If any adjustment was necessary by changing ingredients or their quantities, the recipes would be adjusted and tested again, and the GI and GL values recalculated.

The GI of adapted culinary recipes was calculated by the method proposed by theFood and Agriculture Organization of the United Nations/World Health Organization Expert Consultation[42] for estimating the GI of mixed meals, menus, and culinary recipes. The GI tables proposed by Foster-Powell *et al*.[33] and Atkinson *et al*.[34] and the Brazilian Food CompositionTable [32] were used.

The GI value of culinary recipes was obtained by the sum of the proportion of total glycemic carbohydrates from each ingredient multiplied by the ingredient GI.[42] The GL of each culinary recipe was calculated by multiplying the GI of the food by the amount of carbohydrates per serving and dividing by 100.[33]Recipe GI values less than or equal to 55 and GL values less than or equal to 10 were considered low.[33]

Each NCK cooking class consists of a combination of food preparations commonly consumed at lunch in Brazil. This eating occasion should supply 30% of the total daily energy value.[43] Based on the criteria of Foster-Powell *et al*.[33] for a low daily GL (≤80), we estimated that each meal should comprise a combination of culinary recipes with a total GL of less than 37.5 (30% of the daily GL).

Ethical considerations

The research was approved by the Research Ethics Committee of the Federal University of Santa Catarina (approval number 09475219.6.0000.0121). Participants were assured that there were no right or wrong answers and that everything they said would be kept anonymous. All participants gave their written consent for the interviews to be audio-recorded.

RESULTS

The changes made to NCK recipes and their underlying reasons are shown in Table 1. Of the 32 original recipes, 18 had to be adapted. All adapted recipes were tested, except recipes for baked chicken, mixed salad, and fresh apple.

Table 1. Changes made to culinary recipes from the Nutrition and Culinary in the Kitchen (NCK) program for individuals with type 2 diabetes.

Cooking Classes	Original NCK recipe[30]	Changes and reasons
1	Roasted vegetables (pumpkin, zucchini, eggplant, onion, carrots, and bell pepper)	Substitution of pumpkin (↑GI) for broccoli and cauliflower (↓GI)
	Fruit salad (apple, orange, banana, and papaya)	Substitution of papaya and banana (↑GI) for pear and strawberry (↓GI) and inclusion of cinnamon flavored water (to add flavor)
	Leek omelet	No changes made
	Sautéed chicken	No changes made
	Baked chicken (with orange juice)	Substitution of orange juice for lime juice (↓GI)
	Pressure cooker chicken	No changes made
	Homemade chicken broth	No changes made
	Homemade vegetable broth (carrots, onions, and celery)	No changes made
2	Roasted chicken salad (with orange juice)	Substitution of orange juice for lime juice (↓GI)
	Homemade yogurt sauce with parsley	Recipe excluded because of the high GI of honey. A new recipe was proposed.
	Creamy fruit sherbet (with banana and mango)	Substitution of mango (↑GI) for avocado (↓GI)
	Whole-meal bread made in the frying pan (eggs, whole wheat flour, and white flour)	Substitution of wheat flour (↑GI) for oatmeal (↓GI)
3	Whole-grain rice with garlic	Substitution of rice (↑GI) for cauliflower (↓GI)
	Black beans cooked with pumpkin	Substitution of pumpkin (↑GI) for chayote (↓GI)
	Brazilian style beefsteak with onions	No changes made
	Mixed salad (cauliflower, carrots, tomato, lettuce, basil, and cucumber)	Substitution of cauliflower for broccoli because cauliflower was included in another recipe of the workshop
	Homemade vinaigrette sauce	No changes made
	Fresh orange	Substitution of orange for apple (↓GI)
4	Roasted homemade meatballs	No changes made
	Whole-wheat pasta	Substitution of wheat pasta (↑GI) for seared sautéed zucchini strands (↓GI)
	Homemade tomato sauce	No changes made
	Broccoli salad with lentil (with cashew)	Substitution of cashew for peanut (↓GI)
	Lemon vinaigrette salad dressing	No changes made
	Fresh fruit platter (guava, kiwi, banana, and persimmon)	Substitution of banana and persimmon (↑GI) for pear and strawberry (↓GI)
	Seasoned salt	No changes made
5	Parboiled rice with parsley	Substitution of rice (↑GI) for millet (↓GI)
	Stewed fish with coconut milk (*Moqueca*)	No changes made
	White bean salad with onions, lettuce and tomato	No changes made
	Orange juice, mustard, and honey salad dressing	Recipe excluded because of the high GI of honey and orange juice. A new recipe was proposed.
	Farofa[a]	Addition of collard and eggs to reduce GI
	Fish *pirão*[b]	No changes made
	Oatmeal fruit cake without sweetener or sugar	Exclusion of brown sugar (↑GI)

[a]*Farofa* is a Brazilian dish consisting of cassava flour toasted in fat (oil or butter), generally enriched with other ingredients (vegetables, egg, or meat). [b]*Pirão* is a Brazilian dish made of cassava flour cooked in a hot stock.
↑, high; ↓, low; GI, glycemic index.

Table 2 presents the results of the assessment of food preparations by nutrition experts and the target audience.

Table 2.Qualitative assessment of the sensory attributes of culinary recipes adapted from the Nutrition and Culinary in the Kitchen program for individuals with type 2 diabetes.

Recipe	Phase[1]	Adequacy of sensory attributes					Comments, suggestions, and changes
		Appearance	Color	Aroma	Texture	Flavor	
Roasted vegetables	1	✓	✓	✓	✗	✗	Too much pepper, needs more salt, carrots are undercooked. Changes to carrot cuts. Addition of oregano.
	3	✓	✓	✓	✓	✓	No comments or suggestions.
Fruit salad with cinnamon flavored water	1	✗	✗	✓	✓	✓	Pears were cut into very small pieces that turned brown due to oxidation. Exclusion of pear and inclusion of water flavored with lime, cinnamon, and spearmint.
	2	✓	✓	✓	✓	✓	No comments or suggestions.
	3	✓	✓	✓	✓	✓	No comments or suggestions.
Roasted chicken salad	1	✓	✓	✓	✗	✗	Meat is dry and lacking salt. Lime juice should be applied before salt and in greater amounts.
	2	✓	✓	✓	✓	✗	Meat a bit dry. Changes to the preparation method: chicken cut into pieces while on the baking sheet with the juice.
	3	✓	✓	✓	✓	✓	Chicken pieces are too big. Suggestions on the recipe instructions: addition of the text “Shred or cut the chicken meat into small pieces”.
Yogurt salad dressing	1	✗	✓	✓	✓	✗	Seasonings chopped into large chunks, no taste of spearmint, too acidic. Seasonings cut into smaller pieces, use of more spearmint and less lime juice.
	3	✓	✓	✓	✓	✓	No comments or suggestions.

Table 2.Qualitative assessment of the sensory attributes of culinary recipes adapted from the Nutrition and Culinary in the Kitchen program for individuals with type 2 diabetes.(Continues)

Recipe	Phase[1]	Adequacy of sensory attributes					Comments, suggestions, and changes
		Appearance	Color	Aroma	Texture	Flavor	
Creamy fruit sherbet	1	✓	✓	✓	✗	✗	Lacks acidity and crunchiness. Addition of lime juice, cinnamon, and peanut.
	3	✓	✓	✓	✓	✓	No comments or suggestions.
Oatmeal skillet bread	1	✓	✓	✓	✗	✗	Dry and lacking seasonings. Recipe redesigned.
	2	✗	✓	✓	✓	✓	Not uniformly cooked. Dough needs to be uniformly spread on the skillet.
	3	✓	✓	✓	✗	✓	A bit dry. Changes to the preparation method: water needs to be constantly added to the dough.
Cauliflower with garlic	1	✓	✓	✓	✓	✗	Lacks seasoning. The proportion of water to cauliflower was adjusted, vegetable oil was replaced with olive oil. Changes to the preparation method: cauliflower sautéed with garlic.
	3	✓	✓	✓	✓	✓	No comments or suggestions.
Black beans cooked with chayote	1	✓	✓	✓	✓	✗	Too much cumin. Lacks other seasonings. The amount of water and cumin was reduced.
	3	✓	✓	✓	✓	✓	No comments or suggestions.

Table 2.Qualitative assessment of the sensory attributes of culinary recipes adapted from the Nutrition and Culinary in the Kitchen program for individuals with type 2 diabetes. (Continues)

Recipe	Phase[1]	Adequacy of sensory attributes					Comments, suggestions, and changes
		Appearance	Color	Aroma	Texture	Flavor	
Sautéed zucchini strands	1	✗	✓	✓	✗	✓	Zucchini strands are too thin and there is too much liquid. Changes to the zucchini cut and to the preparation method. Zucchini strands are first sautéed in olive oil.
	2	✓	✓	✓	✓	✓	No comments or suggestions.
	3	✓	✓	✓	✓	✓	No comments or suggestions.
Broccoli salad with lentil	1	✓	✓	✓	✓	✓	No comments or suggestions.
	3	✓	✓	✓	✓	✓	No comments or suggestions.
Fresh fruit platter	1	✗	✗	✓	✓	✓	Pieces too small. Brown. Changes to fruit cuts.
	3	✓	✓	✓	✓	✓	No comments or suggestions.
Millet with parsley	1	✓	✓	✓	✓	✗	Lacks seasoning. More garlic added.
	3	✗	✗	✗	✗	✗	This recipe was not approved by the target audience. Excluded.
Spearmint salad dressing	1	✓	✓	✓	✓	✗	Taste of spearmint too strong. Ingredients changed to 1/2 cup of spearmint and 1/2 cup of basil
	2	✓	✓	✓	✓	✗	Too much salt. Salt was excluded.
	3	✓	✓	✓	✓	✓	No comments or suggestions.
Farofa[2] with collard and eggs	1	✓	✓	✓	✓	✗	Taste of butter is too strong. Butter used at a ratio of 1:1 with vegetable oil.
	3	✓	✓	✓	✓	✓	Add collard stems for increased crunchiness. Changes to the recipe instructions: use collard stems.

Table 2.Qualitative assessment of the sensory attributes of culinary recipes adapted from the Nutrition and Culinary in the Kitchen program for individuals with type 2 diabetes. (Continues)

Recipe	Phase[1]	Adequacy of sensory attributes					Comments, suggestions, and changes
		Appearance	Color	Aroma	Texture	Flavor	
Oatmeal fruit cake without sweetener or sugar	1	✓	✓	✓	✗	✗	Burned taste. Cooking time and temperature need to be closely monitored.
	2	✓	✓	✓	✓	✓	No comments or suggestions.
	3	✓	✓	✓	✓	✓	No comments or suggestions.

[1] Phases are categorized as follows: 1, assessment of sensory characteristics by nutrition experts; 2, retest by nutrition experts for improvement in sensory attributes; 3, qualitative assessment of the sensory characteristics by focus groups with the target audience (individuals with type 2 diabetes). [2]Farofa is a traditional Brazilian dish consisting of cassava flour toasted in fat (oil or butter), generally enriched with other ingredients (vegetables, egg, or meat).
✓, satisfactory; ✗, unsatisfactory.

The expert panel agreed that almost all recipes, except broccoli and lentil salad, required major or minor adjustments. Eight recipes were approved with minor adjustments to the amount of ingredients or preparation technique, precluding further testing. For example, roasted vegetables did not have an adequate flavor because of excess pepper; therefore, the amount of pepper was reduced.

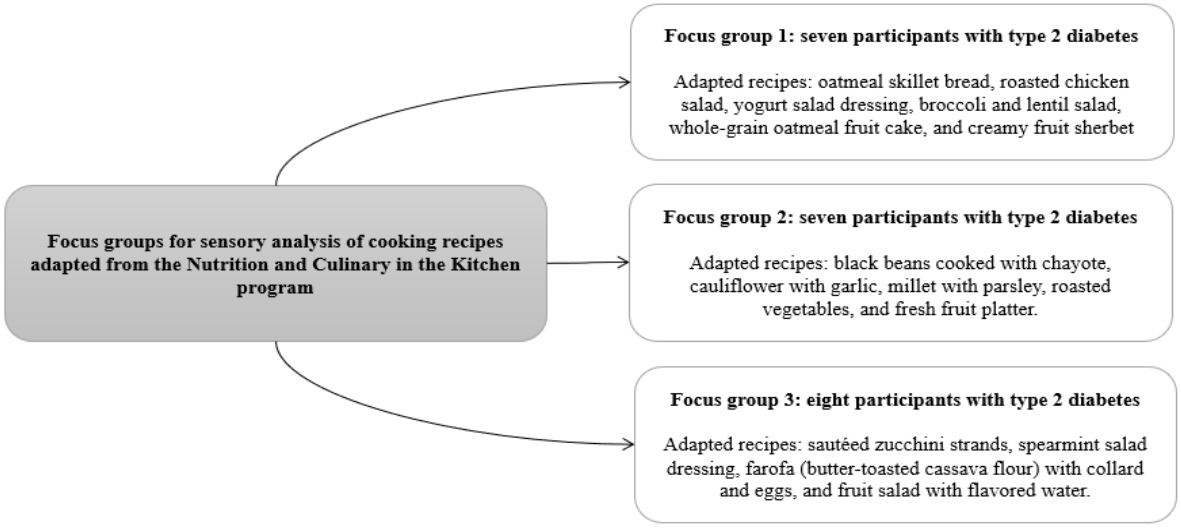
Culinary recipes considered unsatisfactory (fruit salad with cinnamon flavored water, roasted chicken salad, oatmeal skillet bread, sautéed zucchini strands, spearmint salad dressing, and oatmeal fruit cake without intense sweetener or sugar) were readapted and retested or replaced by new recipes. Most of these preparations had an unsatisfactory flavor.

At the retest phase, three recipes were approved without modifications and three with minor modifications. For roasted chicken salad, it was suggested that the chicken be sliced while still on the baking sheet for better broth absorption. For oatmeal skillet bread, it was suggested to uniformly distribute the dough on the skillet. Salt was excluded from the spearmint salad dressing; the experts agreed that this ingredient was not necessary, given the dressing's rich flavor. The three recipes were deemed adequate, provided that these minor modifications were made.

At the third testing phase, the tasting of cooking preparations and discussions in focus groups with individuals with type 2 diabetes mellitus lasted on average 1.5 h. Three focus groups were conducted on separate days with seven, seven, and eight participants each. The same person could participate in all groups; however, for reasons of participants availability, not all individuals participated in the three days of testing. In total, ten individuals with T2DMparticipated in the focus groups. The majority were female (70%), aged between 41 and 60 years (70%), and diagnosed with T2DM for less than 10 years (80%).

Six culinary recipes were tested on the first day (oatmeal skillet bread, roasted chicken salad, yogurt salad dressing, broccoli and lentil salad, oatmeal fruit cake without intense sweetener or sugar, and creamy fruit sherbet), five on the second day (black beans cooked with chayote, cauliflower with garlic, millet with parsley, roasted vegetables, and fresh fruit platter), and four on the third day (sautéed zucchini strands, spearmint salad dressing, *farofa*[butter-toasted cassava flour] with collard and eggs, and fruit salad with cinnamon flavored water), as shown in Figure 2.

Figure 2. Focus groups of individuals with type 2 diabetes for the qualitative assessment of sensory characteristics of culinary recipes adapted from the Nutrition and Culinary in the Kitchen program



Of the 15 recipes evaluated by individuals with T2DM, 13 were approved in all sensory attributes as can be seen in Table 2. The texture of oatmeal skillet bread was deemed inadequate. Thus, recipe instructions were altered to include the constant addition of water during dough preparation, because oatmeal absorbs liquid over time,[44] forming a thick dough, which hinders its even distribution on the skillet. In this sense, applying the suggestion to improve the recipe, a total of 14 recipes were approved by the target audience.

Only millet with parsley was not approved by participants. All sensory attributes were deemed inadequate, as highlighted by Participant 1, "Bland. I wouldn't dream of buying this food."Therefore, the recipe for millet with parsley was excluded. We decided not to include a new culinary recipe because two other recipes with carbohydrate sources had been approved by the same cooking class of the original NCK program, *farofa* and *pirão* (fish stew with cassava flour).

All sweet culinary recipes were approved in all sensory attributes, even those prepared without the addition of sugars or intense sweeteners, as evidenced by the following excerpts: "The fruit dish had a perfect combination. The appearance was perfect. Excellent!" (Participant 4). "I really liked the fruit salad. The cinnamon was great. Perfect blend" (Participant 5). "The cake was a delight! It doesn't even need sugar; it's excellent" (Participant 6).

The food preparations that replaced traditional Brazilian cuisine dishes, such as rice and pasta, were also greatly approved. "Cauliflower surely can replace rice. I loved it!" (Participant 2). "I hadn't tried that yet. Zucchini was a perfect pasta substitute" (Participant 1).

One of the strategies of the NCK program to reduce the use of salt and sugar is to use herbs and spices. This substitution was well accepted by participants, such as in the recipe for black beans cooked with chayote seasoned with cumin and fruit salad with cinnamon flavored water. "I'm impressed that things I don't use or like turned into something good. Cinnamon was very good" (Participant 3).

Food preparations containing vegetables and low-fat animal protein, such as the broccoli and lentil salad and roasted chicken salad, were approved by all participants. Participant 8 stated that "the salad was

very good; the chicken was very soft." "I really like lentils," reported Participant 5, "the taste of the salad was excellent."

During the focus groups, minor changes were suggested regarding the method of preparation or the use of some ingredients. However, these suggestions did not influence participants' approval of recipes, and, therefore, a new test was not required. Suggestions were mostly related to cuts of ingredients. For example, participants suggested changing the cuts of vegetables or meats in salads according to personal taste. For the *farofa* recipe, the use of collard stems was proposed to make use of the vegetable as a whole and enhance texture and crispness.

The GI and GL of culinary recipes approved by the target audience are presented in Table 3.

Table 3.Glycemic index and glycemic load of recipes adapted from the Nutrition and Culinary in the Kitchen program for individuals with type 2 diabetes.

Cooking Classes	Recipe	GI	Total GL	GL per serving	GL per meal
1	Roasted vegetables	2.9	0.5	0.2	6.6
	Fruit salad with cinnamon flavored water	29.9	15.5	5.2	
	Leek omelet	0.0	0.0	0.0	
	Sautéed chicken	0.0	0.0	0.0	
	Baked chicken	0.0	0.0	0.0	
	Pressure cooker chicken	12.4	1.0	0.3	
	Homemade chicken broth	0.0	0.0	0.0	
	Homemade vegetable broth	8.9	0.9	0.9	
2	Roasted chicken salad	13.9	4.2	1.4	11.2
	Yogurt salad dressing	12.3	0.8	0.3	
	Creamy fruit sherbet	26.3	15.4	3.8	
	Oatmeal skillet bread	46.3	5.7	5.7	
3	Cauliflower with garlic	0.0	0.0	0.0	3.4
	Black beans cooked with chayote	13.1	3.7	0.6	
	Brazilian style beefsteak with onions	0.0	0.0	0.0	
	Mixed salad	13.9	1.2	0.2	
	Homemade vinaigrette dressing	0.0	0.0	0.0	
	Fresh apple[36]	25.0	2.6	2.6	
4	Roasted homemade meatballs	22.2	2.2	0.2	3.9
	Sautéed zucchini strands	0.0	0.0	0.0	
	Homemade tomato sauce	0.0	0.0	0.0	
	Broccoli and lentil salad	17.7	5.9	1.9	
	Lemon vinaigrette salad dressing	0.0	0.0	0.0	
	Fresh fruit platter	29.9	7.1	1.8	
5	*Moqueca*[a]	0.0	0.0	0.0	20.7
	White bean salad with onions, lettuce and, tomato	18.1	16.1	2.7	
	Spearmint salad dressing	0.0	0.0	0.0	
	Farofa[b]	48.4	86.0	7.2	
	Fish *pirão*[c]	51.5	25.8	4.3	
	Oatmeal fruit cake without sweetener or sugar	40.9	77.8	6.5	

[a]*Moqueca* is a traditional Brazilian dish of fish stew with coconut milk.[b]*Farofa* is a Brazilian dish consisting of cassava flour toasted in fat (oil or butter), generally enriched with other ingredients (vegetables, egg, or meat). [c]*Pirão* is a Brazilian dish made of cassava flour cooked in a hot stock.

GI, weighted mean glycemic index; GL, glycemic load.

All recipes had low GI (≤55), ranging from 0.0 to 51.5; low GL per serving (≤10), ranging from 0.0 to 7.2; and low GL per meal (<37.5), ranging from 3.4 to 20.7.

DISCUSSION

Of the 32 original NCK recipes, 18 had to be modified for individuals with T2DM. The other culinary recipes (*n* = 14) did not require alterations because they had low GI. One recipe was excluded for not being approved by the target audience (millet with parsley). Thus, 31 culinary recipes with low GI and GL were selected for the subsequent study that applied NCK intervention with individuals with T2DM.

In one of the recipes, rice was replaced with chopped cauliflower (which was prepared with garlic in the same manner as rice) to reduce the GI. This strategy could compromise the food's acceptance by participants, as rice is one of the main staple foods of the Brazilian population and an ingredient of the traditional dish rice and beans.[45,46] Nevertheless, this substitution was well accepted by the target population. We highlight that the substitution of rice for cauliflower is not intended to discourage the consumption of rice and beans but to provide an alternative to reduce the GI of meals for individuals with T2DM.

None of the culinary recipes used added sugars or intense sweeteners. Studies have shown that most individuals with T2DM use intense sweeteners in food and beverages.[47,48] According to the literature, there may be harmful effects resulting from the intake of intense sweeteners, especially in T2DM patients, as it may interfere with glycemic homeostasis, induce glucose tolerance, and affect intestinal microbiota and the gut-brain axis.[49,50]According to the WHO guideline regarding the use of non-sugar sweeteners, there is "no evidence of long-term benefit on measures of body fatness in adults or children, and potential undesirable effects from long-term use in the form of increased risk of type 2 diabetes, CVDs and mortality in adults".[51]The Brazilian Diabetes Society emphasizes that intense sweeteners, although an alternative in sugar-restricted diets, are not essential for the treatment of diabetes, as opposed to glycemic monitoring and, in some cases, oral medication and insulin.[6]

Studies evaluating the taste sensation of individuals with T2DM identified reduced response to the perception of intense sweetness, followed by sourness and saltiness.[52,53]These changes in taste can influence food choice and the preference for sweet foods.[52] However, in the present study, despite the lack of added sugars and intense sweeteners in culinary recipes, all sweet culinary recipes were approved by the participants.

The adapted NCK culinary recipes had satisfactory flavor. We highlight the use of herbs and spices as a strategy to enhance flavor. These ingredients are recommended to improve engagement to diets restricted in sodium and sugar and increase the consumption of vegetable-based dishes.[54-56]

In general, individuals with T2DM have low consumption of fruits and vegetables.[14,15,57] The World Health Organization and diabetes guidelines highlight the importance of consuming fruits and vegetables to reduce the risk of developing noncommunicable diseases, ensure an adequate daily intake of dietary fiber, and to glycemic stability.[5,6,58] Recipes based on fruits and vegetables proposed in the present study were well accepted by the target audience. The adapted culinary recipes included common Brazilian ingredients as well as different food combinations and seasonings, achieving high approval by the target audience.

Involvement with diet therapy is fundamental for the prevention of T2DM complications and for glycemic stability.[59] However, individuals with T2DM have difficulty in engaging prescribed diets.[13,14] Among the barriers to diet engagement, we highlight the difficulty in changing their diets, lack of diet palatability,[60] and lack of information about the condition[61] and about healthy diets.[62] In this study, according to reports

obtained during the focus groups, the adapted culinary recipes aroused the interest of participants in learning how to prepare the approved culinary recipes. The results of this study show that it is possible to elaborate healthy and tasty culinary recipes with low GI and GL that are well accepted by individuals with T2DM. The concern with the potential acceptability of the foods substituted was one of the reasons why we used the qualitative method in the evaluation by the target audience.

As limitations, it should be noted that this qualitative study considered the view of a small number of subjects, predominantly female, from a single municipality in Brazil; therefore, the results cannot be generalized. However, the main objective of the study was to gather opinions of people with T2DM and, from the minutiae of the reports of participants made according to their reality, modify the culinary recipes. The focus group technique was applied to identify and understand the opinions of the target group, not to extract generalizations.[38] Thus, although the study sample was not representative of the population who has T2DM in Brazil, the focus groups allowed an in-depth evaluation of the aspects of culinary recipes suggested for adaptation by individuals with T2DM.It should be emphasized that not all dietary treatment protocols for individuals with T2DM restrict the consumption of foods with high GI; however, isolated consumption of high GI foods, such as sugar, is not recommended.[5,6] The purpose of the modification of NCK culinary recipes was to introduce foods with low GI values that are not usually consumed as alternatives to common, high GI foods. We highlight that culinary recipes, not diets, were adapted. These recipes can be used in diets composed of other foods, whether of low or medium GI, if health professionals guide diet choice.

The strength of the present studies lies firstly in its novelty. This is the first Brazilian study to modify culinary recipes for individuals with T2DM and evaluate their acceptability by the target audience.

This study also adds to the theory by describing methods for selection, adaptation, and development of culinary recipes for individuals with T2DM, since there is a lack of national and international literature which has done it. In the literature review, it was identified the need to advance in intervention studies through the development of an earlier stage that would provide greater methodological care and increase the chances of the interventions' success.[63,64] This study comes from the need to carry out intervention studies more carefully planned by preliminary studies before execution, as their lack may be precisely the reason for the failure of the interventions.

The results can integrate dietary guidelines on diabetes and be applied to interventions aimed at the development of cooking skills and healthy eating habits in individuals with T2DM. Policy regarding health education on cooking skills are an opportunity to qualify and improve actions to fight diabetes mellitus in the context of public health.

The criteria defined for adapting the culinary recipes followed the guidelines of World Health Organization[65] and diabetes guidelines from several countries, such as United States of América, Brazil and Canadá.[5-7] Thus, the methodological design created in this study can be used to adapt culinary intervention programs to other populations or countries.

We emphasize that the publication of this type of methodological study only adds to the science, as, in addition to improving our own further study, it brings tools to help other researchers to plan evidence-based intervention studies more quickly and effectively.

CONCLUSIONS

The adapted culinary recipes were approved by individuals with T2DM and may be incorporated in future cooking intervention programs. Such programs can contribute to glycemic monitoring, involvement to diet therapy, and development of healthier eating habits in this population group. The tested and approved culinary recipes improve the possibility of programs' success, since people can learn to prepare a recipe, but they will not practice it if they do not like to

eat the dish. To the best of our knowledge, no other culinary intervention programs targeted to individuals with T2DM have developed a detailed methodology for the selection, adaptation, and testing of low GI culinary recipes.

The results showed that it is possible to elaborate healthy, tasty meals with low GI for individuals with T2DM. The method designed in this study for adapting culinary recipes can be used for the modification of recipes for different target audiences around the world. Also, the data can be used to define cooking recipes for cooking interventions aimed at individuals with T2DM and with other chronic noncommunicable diseases. Future studies should apply the adapted culinary recipes in interventions aimed at the development of cooking skills and healthy eating habits in individuals with T2DM.

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Contributors

Proença RPC designed the study. Proença RPC, Fernandes AC andBernardo GL coordinated the study. Fernandes AC and Bernardo GL supervised the study. TS contributed to the supervision and execution of the study. Geraldo APG, Uggioni PL, Rodrigues VM and Rieger DK contributed to the study design and interpretation and discussion of data. Tiecher CV collected, analyzed, and interpreted the data and wrote the first draft of the manuscript. Silva FLMR collaborated in the update of literature and contributed to the improvement of the text. All authors contributed to writing and revising the manuscript and approved the final version of the article.

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