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Research Article

Designing Menu for a 1550-calorie Indian Diet with Balanced Fats and Restricted Carbohydrates for Diabetic Adults with Heart Failure

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Abstract

The study for designing an Indian menu-based equivalent of the Mediterranean diet, tailored to the context of heart failure in diabetes, was planned in the situation of, menu formulations or any formulating guidelines for a situationally suitable native diet for Indian diabetic adults in heart failure remained hypothetical, since 2010. The parameters determining situational suitability were bulkiness (that is, less bulky food for less flatulence and lesser bowel movements, in bed ridden patients) and reasonable adequacies in calories, macro and micronutrients. So, the first objective of the work was to design a menu for a less bulky but reasonably nutritious diet of 1550.00 Calories for diabetic persons in rest for heart failure (HF) calorically similar to the known diet models with carbohydrate derived energy limited to 50.00% (the Traditional Mediterranean diet or the American Diabetes Association diet for diabetic persons) and fat limited to 30.00g, using Indian native food items. The second objective was, to demonstrate deriving dietary fat according to the classic consumption recommendations, to consume saturated, monounsaturated, and poly unsaturated fats in equal amounts, keeping the ratio between the omega 6 type and omega 3 type fatty acids (the 'omega ratio') as 4:1 (balanced fat), from the items of the menu. The essential methodology for total calorie calculation was, mathematically combining the calorie provision pattern of the known diabetic diet models with 50.00% energy from carbohydrate and the recommendation in classic text books to reduce the fat consumption to 30.00g, while resting with HF. The methodology for constituting the menu was plotting a table with less bulky but nutritively denser food items in columns and their nutritive values in rows, selected from a panel of 592 local food items. With a few repetitions of tabulation involving permutations and combinations of certain local food items, a model was evolved with 15 of them, satisfying both the objectives. Both the methodology of formulation and its interim evaluation tables are, essential guiding gridworks for preparation and assessment of other metabolically targeted diets also. Since being a derivative of already well accepted models just substituted with some nutritionally equivalent native food items, the clinical evaluation of the formulation will be quite simpler too. The socio-economic significance of the menu combination is its highly predictable acceptability due to the compositional familiarity and lighter budgetary load, to the Indian population (traditional food items in near traditional quantities, on minimum expense).

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1. Introduction

The format of Traditional Mediterranean diet (TM) or American Diabetes Association diet (ADA diet) for diabetic persons, recommend to limit the carbohydrate derived energy to 50.00% with compensatory hikes in the other two proximate principles for the rest of energy - that is, calories from protein and fat (14.00% and 36.00%, respectively), for a day's calorie needs of a diabetic adult person [1]. For deriving energy in such a pattern from a diet of 2000.00 Calories, the person has to consume 250.00g of carbohydrate (for 1000.00 Calories), 70.00g protein (for 280.00 Calories) and 80.00g fat (for 270.00 Calories), in terms of modern or traditional food items (e.g., rice or wheat, pulses and oils). But, since the energy needs come down on sustaining heart failure (due to the reduced physical activity or absolute bed rest following heart failure / HF), the *classic clinical nutrition text books recommend to reduce the fat consumption to 30.00g, on these days* [2]. On trying to constitute a diet combining these two recommendations together, will technically end up in menu formation for a diet of 1550.00 Calories with its 64.52% energy from carbohydrate (i.e., 1000 =1550 x 64.25/100) 18.06% energy from protein (i.e., 280 =1550 x 18.06/100) and 17.42% energy from the fat (i.e., 270 =1550 x 17.42/100). Another clinical recommendation significant in the contexts of HF management practice is to provide the patient, with less bulky or least bulky foods on these days for calorie requirements, for simple reasons like the respiratory discomforts and abdominal discomforts on taking bulky diets. So, diets with essentially lesser calories (e.g., 1550.00 Calories) constituted with least bulky (i.e., nutritively compact) food items, becomes the genuine dietary option for situations of HF, in clinical practice.

The authors' attempt here is to constitute a menu table for preparing the least bulky, nutritious diet of 1550.00 Calories, with an additional advantage of fat provision according to the classic consumption recommendations, with some of the traditional food items of Indian kitchens. This is because of the presence of food items prevalent in the mediterranean region or in the western hemisphere, in both of the above mentioned two diet models and hence the difficulty in availing them in India for day to day use. The classic fat consumption recommendations (seen in maximum number of journals and text books) tell us to consume saturated, monounsaturated, and poly unsaturated fats in equal amounts, keeping the ratio between the omega 6 type and omega 3 type fatty acids (the 'omega ratio') as 4:1 [3]. The significance of the new menu model with its mathematically derived nutritional quality predictions on the diet constituted with it, is in its ability to form mold for easy casting of metabolically targeted diet models for other similar or different health conditions. Basically, being a derivative formulation of the already well accepted models (the TM and ADA models), on just substitution with nutritively equivalent traditional Indian food items in near traditional quantities, the clinical evaluation of the new formulation will be comparatively simpler too, without the typical xenobiotic evaluation steps like toxicological evaluation or animal experimentations. For the same basic reason and low budgetary load, the acceptability of the new menu model will be predictably high too.

2. Materials and Methods

2.1. The Initial Steps

As the first step of workup, for deriving 64.52% energy (i.e., 1000.00, out of the 1550.00 Calories) from the carbohydrate and 18.06% energy (i.e., 280.00, out of the 1550.00 Calories) from protein, in the traditional way of menu selection (i.e., selecting food items for their predominantly known contents), 250.00g of rice and 70.00g of green gram dal were selected (1000/4=250) to the menu formulation [3]. But on finding that constitutionally neither of the items were pure sources of carbohydrate or protein, the rice – green gram dal combination (*the cereal – pulse combination, in general*) was later modified with 130.00g of rice and 80.00g of green gram dal, with additions of 50.00g whole wheat flour (atta), 50.00g uncooked oats, 60.00g apple (smaller size) and 33.50g raw egg yolk, for the reasons under mentioned [4-9]. Still it was found that the above combination meant for availing the required amounts of carbohydrate and protein for the day (i.e., 250.00g and 70.00g, respectively) could provide 217.19g of carbohydrate and 48.51g of protein only, due to the unique natural compositions of the food items selected (all being admixtures carbohydrate and protein along with some fat). Thus the combination left a carbohydrate deficit of -32.81g and protein deficit of -21.49g, towards their daily requirements (that is the inherent carbohydrate and protein deficits of the modified cereals - pulse combination). On interpreting these deficits against total structure of the menu formulation, were found to be essential, for adequate accommodation of the carbohydrate and protein moieties of the yet to be added items like the protective foods (for vitamins and minerals) and fat sources, which justified the correc-

tions made in the amounts of rice, green gram dal (Table 1- block A, I and table S1) and, also addition of other items.

Table 1. *Carbohydrate, Protein, Fat & Dietary fiber from specific quantity of each food item.*

Food items		**BLOCK A**		**BLOCK B**		
I. The cereal – Pulse block	**CHO (in g) Target 250.00g *(excluding fiber -in g)***	**PROTEIN (in g) Target 70.00g**	**FIBER (in g) Target 38.00g**	***SAFA (in g)** **1. The initial fat combination**	**MUFA (in g)**	**PUFA (in g)**
1. Rice, parboiled, milled 130.00g [4] 0.43	100.31	10.15	4.86	0.20	0.11	0.28
2. Wheat whole flour (atta) 50.00g [5]	32.08	5.29	5.68	0.10	0.07	0.37
3. Oats, uncooked 50.00g [6]	33.15	8.45	5.30	0.60	1.09	1.27
4. Apple, smaller size 60.00g [7]	8.37	0.19	1.24	0.09	0.03	0.13 ** (0.02 O3)
5. Green gram dal 80.00g [8]	42.07	19.10	7.50	0.20	0.03	0.42 (0.13 O3)
6. Egg yolk, raw 33.50 [9]	1.21	5.33	0.00	3.22	3.93	1.41
TOTAL: CHO, Protein & Fiber	217.19	48.51	24.58			
Inherent deficits of the modified cereals – pulse combination	*-32.81*	*-21.49*				
II. The fat /oil block						
7. Milk 250.00g [10]	12.00	7.88	0.00	4.65	2.03	0.50
8. Fenugreek seeds 12.50g [11]	1.32	3.18	5.94	0.10	0.09	0.39 (0.14 O3)
9. Sunflower oil 4.50g [12]				0.46	0.88	2.96
10. Flaxseed 7.50g (3.00tsp. pwdr) [13]	*0.12*	*1.37*	*2.05*	0.27	0.56	2.15 (1.71 O3)
11. Olive oil 1.50g [14]				0.21	1.09	0.16
TOTALS	13.44	12.43	7.99	10.10	9.91	10.04
The remaining inherent deficits of the modified cereals – pulse combination	*-19.37*	*-9.06*				
III. The protectives' block				II. Fats from protective food items - Details		
12. Indian gooseberry 15.00g [15]	2.06	0.08	0.51			
13. Ginger, fresh 5.00g [16]	0.45	0.11	0.27			
14. Arrowroot flour 19.00g [17]	16.11	0.06	0.65			
15. Egg white, raw 80.00g [18]	0.58	8.72	0.00			
TOTALS	19.20	8.97	1.43			Total PUFA – 10.04 (Total omega 6 – 8.04 Total **omega 3 – 2.00)
The final residual deficits left	- 0.17g	-0.09g				
DIFFERENCE: TARGET -TOTAL	250.00 - 249.83 = - 0.17g Nominal residual deficit *(clinically insignificant)*	70.00 – 69.91 = -0.09g Nominal residual deficit *(clinically insignificant)*	Grand total =34.00g	*SAFA, Saturated fatty acids; MUFA, Mono unsaturated fatty acids; PUFA, poly unsaturated fatty acids.		

2.2. Interim Nutritive Evaluation 1

The above combination primarily meant for carbohydrate and protein (cereals, pulse and other items) additionally provided 15.22g of fat and, all essential amino acids except the methionine-cysteine duo, in required amounts. Among the other nutrients phosphorus, iron, copper, selenium, molybdenum and manganese were provided adequately (Table 2 and S1).

Table 2. *Protective nutrients & essential amino acids from the modified cereals - pulse combination.*

Table 2	*FAT SOUBLE VITAMINS			
Food items **Nutrients:**	**Vitamin A (IU or mcg)**	**Vitamin D (mcg)**	**Vitamin E (mg)**	**Vitamin K (mcg)**
Rice, parboiled, milled 130.00g	0.00	0.00	0.08	1.95
Wheat flour (atta) 50.00g	1.34	6.72	0.11	0.75
Oats, uncooked 50.00g	0.00	0.00	0.00	0.00
Apple, smaller size 60.00g	1.25	1.12	0.04	1.31
Green gram dal 80.00g	0.98	1.64	0.05	6.64
Egg yolk, raw 33.50g	29.48 (B. Caro.)&	1.81	0.87	0.23
TOTAL *Stored nutrients	124.29 (Retinol) 33.05 (B.Carot.) & 124.29 (Retinol)	11.29	1.15	10.88

Table 2	WATER SOLUBLE VITAMINS							
Food items **Nutrients:**	**Thiamin (B1) (mg)**	**Riboflavin (B2) (mg)**	**Niacin (B3) (mg)**	**Pyridoxine (B6) (mg)**	**Pantothenic acid (B5) mg)**	**Folate (B9) (mcg)**	**Vitamin B12 (mcg)**	**Vitamin C (mg)**
Rice, parboiled, milled 130.00g	0.22	0.08	3.26	0.29	0.72	12.68	0.00	0.00
Wheat flour (atta) 50.00g	0.21	0.08	1.19	0.13	0.44	14.61	0.00	0.00
Oats, uncooked 50.00g	0.38	0.07	0.48	0.06	0.65	28.00	-	-
Apple, smaller size 60.00g	0.01	0.01	0.05	0.02	0.05	2.11	-	2.40
Green gram dal 80.00g	0.28	0.10	1.47	0.15	1.34	93.69	-	-
Egg yolk, raw 33.50g	0.06	0.18	0.01	0.12	1.01	48.91	0.67	0.00
TOTAL Remarks: (' - ') - Not detectable in the mentioned qty.)	1.16	0.52	6.46	0.77	4.21	200.00	0.67 Stored nutrient	2.40

Table 2	MINERALS & TRACE ELEMENTS													
Food items **Nutrients:**	**Calcium (mg)**	**Phosphorus (mg)**	**Magnesium (mg)**	**Sodium (mg)**	**Potassium (mg)**	**Iron (mg)**	**Iodine (mcg)**	**Fluoride (mg)**	**Zinc (mg)**	**Copper (mcg)**	**Chromium (mcg)**	**Selenium (mcg)**	**Molybdenum (mcg)**	**Manganese (mg)**	**Chloride (g)**
Rice, parboiled, milled	10.54	182.	34.7	4.11	184.	0.94	-	-	1.40	351.	*6.50*	1.55	*71.5*	1.03	-

Table 2 **MINERALS & TRACE ELEMENTS**

Food items	Nutrients:	Calcium (mg)	Phosphorus (mg)	Magnesium (mg)	Sodium (mg)	Potassium (mg)	Iron (mg)	Iodine (mcg)	Fluoride (mg)	Zinc (mg)	Copper (mcg)	Chromium (mcg)	Selenium (mcg)	Molybdenum (mcg)	Manganese (mg)	Chloride (g)
130.00g			00	4		60					00			*0*		
Wheat flour (atta) 50.00g		15.47	157.50	62.50	1.02	155.50	2.05	0.00	0.00	1.43	240.00	*3.00*	26.56	*11.00*	1.49	-
Oats, uncooked 50.00g		27.00	261.50	88.50	1.00	214.50	2.35	0.00	0.00	2.00	315.00	-	-	-	2.45	-
Apple, smaller size 60.00g		3.23	5.03	3.29	0.87	60.00	0.15	-	-	-	-	-	-	-	-	-
Green gram dal 80.00g		34.50	332.80	1.24	8.11	1014.40	3.14	0.00	0.00	2.00	776.00	*1.60*	40.11	*129.60*	0.78	-
Egg yolk, raw 33.50g		43.22	130.65	1.68	16.08	36.52	0.90	-	-	0.77	26.80	-	18.76	-	0.02	-
TOTAL		133.96	1069.48	191.95	31.19	1665.52	9.53	-	-	7.60	1708.80	11.10	86.98	212.10	5.75	-

Bold – Adequate [21]

Remarks : (' - ') - Not detectable in the mentioned qty.

Table 2 **ESSENTIAL AMINO ACIDS (ADULT MALE – 70.00kg)**

Food items	Nutrients :	Histidine (mg)	Isoleucine (mg)	Leucine (mg)	Lysine (mg)	*Methionine (mg)	**Phenylalanine (mg)	Tyrosine (mg)	Threonine (mg)	Tryptophan (mg)	Valine (mg)
Rice, parboiled, milled 130.00g		238.59	420.34	820.37	347.23	251.80	521.86	449.77	328.95	116.75	635.58
Wheat flour (atta) 50.00g		135.30	199.78	323.97	128.00	93.50	265.84	111.00	136.36	52.32	270.59
Oats, uncooked 50.00g		202.50	347.00	642.00	350.50	156.00	447.50	286.50	287.50	117.00	468.50
Apple, smaller size 60.00g		4.39	7.18	10.62	5.32	2.36	6.95	4.49	7.57	1.58	8.15
Green gram dal 80.00g		487.15	777.54	1509.22	1163.43	200.59	1184.45	563.57	641.90	236.89	995.32
Egg yolk, raw 33.50g		139.36	290.11	468.67	407.70	126.63	228.14	227.13	230.15	59.30	317.92
TOTAL		1207.29	2041.95	3774.85	2401.68	830.88	2654.74	1642.46	1632.43	583.84	2696.06

*With cysteine ER-1050.00
** With tyrosine ER- 1750.00
Bold – Adequate [20]

As the second step of the workup, since none of the natural dietary sources of fat were found constituted with equal amounts of saturated, mono unsaturated and poly unsaturated fats, with an internal omega ratio of 4:1, authors tried to constitute combinations of food sources with significant fat content (the 'fat combination'), and make them part of the menu formulation, satisfying the classic consumption recommendations.

Thus for deriving the remaining 17.42% of energy (i.e., 270.00 Calories) from fat initially a total quota of 30.00g oils were tried (i.e., 270.00/9.00 = 30.00), empirically selecting one SAFA (saturated fatty acid) predominant, one MUFA (mono unsaturated fatty acid) predominant and one PUFA (poly unsaturated fatty acid) predominant oil (here coconut oil,

olive oil and sunflower oil, respectively), from the locality. But finding that mere oil combinations provided nothing to fill up the inherent carbohydrate and protein deficits of the modified cereals - pulse combination, trials were repeated with added oil seeds and milk. The particular combination given below (Table 1- block A, II, Table 3 and S3) with inclusion of milk, fenugreek seeds, sunflower oil, flaxseed and olive oil [10-14] was thus derived, which additionally provided around 13.00g of carbohydrate and 12.00g of protein towards the inherent carbohydrate and protein deficits of the modified cereals – pulse combination (Table 1- block A, II), leaving still around -19.00g of carbohydrate and -9.00g of protein deficits to be filled later, for the day [the remaining inherent carbohydrate (-32.81g + 13.44g = -19.37g) and protein deficits (-21.49g + 12.43g = - 9.06g) of the modified cereals – pulse combination, after addition of the fat sources]. The protein provided by the flaxseed, fenugreek seed and milk was of first class quality too (rich in essential amino acids).

The specific quantities of fat sources mentioned above were found out by, calculating the weight of each item capable of providing the required amount of particular fat type (e.g., MUFA) to the trial tabulation, along with other types. The specific quantity of each fat source was calculated by multiplying the 'reciprocal of fraction value' of a particular fat type (e.g., MUFA) in it, with its 'required amount' to the trial tabulation. That is, for getting 'y' grams of the particular fat type (e.g., MUFA) from 100.00 gram of an oil containing its 'x' grams, the calculation was like, 100.00 divided by 'x, into 'y'. Then, the customary food item of Indian villagers – milk - was added for equalizing the gains of SAFA, MUFA and PUFA to the limitation of 26.70g, and also for providing a reasonable amount of vitamin B12. Flaxseeds were selected to the combination (instead of flaxseed oil, due the comparatively wider availability of the former item all over India) as the main source of omega-3 fatty acids and, fenugreek seeds were added for their traditionally known antidiabetic effects, among Indians.

Table 3. *Combination of dietary fat sources, presenting saturated, mono unsaturated and poly unsaturated fatty acids in equal quantities and 4:1 omega ratio of the poly unsaturated compartment [4-14].*

Fatty acids (in grams)			
Food items (in grams)	***SAFA**	**MUFA**	**PUFA**
1. Rice, parboiled, milled 130.00g [4]	0.20	0.11	0.28
2. Wheat whole flour (atta) 50.00g [5]	0.10	0.07	0.37
3. Oats, uncooked 50.00g [6]	0.60	1.09	1.27
4. Apple, smaller size 60.00g [7]	0.09	0.03	0.13 (**0.02 O3)
5. Green gram dal 80.00g [8]	0.20	0.03	0.42 (0.13 O3)
6. Egg yolk, raw 33.50 [9]	3.22	3.93	1.41
7. Milk 250.00g [10]	4.65	2.03	0.50
8. Fenugreek seeds 12.50g [11]	0.10	0.09	0.39 (0.14 O3)
9. Sunflower oil 4.50g [12]	0.46	0.88	2.96
10. Flaxseed 7.50g (3.00 tsp. powder) [13]	0.27	0.56	2.15 (1.71 O3)
11. Olive oil 1.50g [14]	0.21	1.09	0.16
‡Total	10.10	9.91	10.04

*SAFA, Saturated fatty acids; MUFA, Mono unsaturated fatty acids;
PUFA, poly unsaturated fatty acids. **Omega 3 fatty acid.
‡Regarding the totals: The minor variations of the total figures of lowermost columns, from 10.00g (within a rage of $\pm$ 0.30g) are due to the unique natural nutritive compositions of oils and also because of rounding up of quantities of oils and oil sources to full figures or 0.50g levels).

2.3. Nutritive Assessment of the Combination of Fat Sources

The combination given above clearly showed, SAFA, MUFA and PUFA entities in equal quantities (10.00g each; with minor variations within a range of + 0.30g, due to the unique natural compositions of oils and because of rounding up of oil quantities to full figures or 0.50g levels).

At this point, the nutritive structure of fats altogether (of the

fat sources and the modified cereals -pulse combination) revealed that, except the oils in flaxseed, fenugreek seeds, apple and green gram dal contained omega-6 fatty acids only, in their PUFA fractions, accounting for a total of 8.04g of omega-6 fatty acids in the combination (from the readings of the last column of table 1- block B, I and table 3) [4 -14].

So mathematically, for keeping the omega ratio as 4:1, rest of the PUFA compartment of the combination had to be filled with omega-3 fatty acids (that is 10.04 minus 8.04 = 2.00g of omega-3 fatty acids). In the working combination the amount was provided by 3.17g of flaxseed oil present in 7.50g flaxseed (because its 2.15g of PUFA fraction contains 1.71g omega-3 and 0.44g omega-6 fatty acids), and also by 0.14g of omega -3 fatty acids present in 12.50g fenugreek seeds, 0.13g present in 80.00g green gram dal and 0.02g present in 60.00g of apple. Thus the ratio between 8.04g of omega-6 acids and 2.00g of omega-3 acids turned 4:1. The quantity of flaxseed was rounded to 7.50g, for the convenience of kitchen measurement too (around 3.00 teaspoons of flaxseed powder).

2.4. Interim Nutritive Evaluation 2

So, after adding the combination of fat sources, a carbohydrate deficit of -19.37g and protein deficit of -9.06g (the remaining inherent carbohydrate and protein deficits of the modified cereals – pulse combination, after addition of the fat sources) existed for accommodating the carbohydrate and protein moieties of the yet to be added protective foods. Till this moment, the modified cereals-pulse combination and the combination of fat sources had provided significant amount (32.57g – that is 85.71% of dietary reference intake), of dietary fibers too (table 1- block A, II and Table S1).

2.5. Selection and Addition of Protective Food Items to the Model Menu

At this point, since it was found that the vegetables consumed as protective food items form the major bulk of Indian traditional diets authors decided to limit their total apparent quantity by selecting only two non-bulky items (Indian gooseberry for vitamin C and ginger fresh for taste, in nominal quantities). The arrowroot flour and raw egg white was added for making up the carbohydrate and protein deficits, remained after the addition of the fat sources (-19.37g and -9.06g, respectively; table 1- block A, II) [15-18].

2.6. Interim Nutritive Evaluation 3

The protective food items shown in Table 1 (block A, III) on adding, provided sufficient carbohydrate and protein moieties (19.20g and 8.97g, respectively) for filling up the final carbohydrate and protein deficits of the day (remained after the addition of combination of fat sources), with some nominal residual deficits of negligible significance in clinical nutrition (19.20g carbohydrate instead of 19.37g and 8.97g protein instead of 9.06g, respectively). They also improved the fiber level to 89.47% (i.e., 34.00g) and pulled up the levels of most of the protective nutrients (Table 1- block A, III and S1).

The combination of fat sources and protective food items together improved the protective nutrient and essential amino acid levels of the menu by lifting up the levels of thiamin, riboflavin, pantothenic acid, vitamin C, vitamin D and the methionine-cysteine duo, well above their daily adequacy levels (Table 4 and S4), but well below their 'tolerable upper levels' (TULs) (table S2) [19]. Still partial deficiencies of dietary fiber and a few protective nutrients continued in the menu table like those of the minerals (ranging from 14.00% to 81.00%), non-stored vitamins (ranging from 22.00% to 54.00%) and stored vitamins (ranging from 22.00% to 86.00%), due to the natural reason of reducing the number and quantities of food items targeted for a diet of lower than the usual calorific value (of 1550.00) and of lesser bulk.

Table 4. *Protective nutrients & essential amino acids from the constituent food items of the new menu formulation.*

Table 4	**FAT SOUBLE VITAMINS**			
Food items Nutrients :	**Vitamin A (IU or mcg)**	**Vitamin D (mcg)**	**Vitamin E (mg)**	**Vitamin K (mcg)**
From the cereals – pulse combination	33.05 (B. carot.)	11.29	1.15	10.88
Milk 250.00g (excluding added vit. D)	112.50 (Retinol)	3.25	0.18	3.25
Fenugreek seeds 12.50g	17.75	0.25	0.00	0.19
Sunflower oil 4.50g	-	-	2.26	0.30
Flaxseed 7.50g (3.00 tsp. pwdr)	-	-	0.02	0.22
Olive oil 1.50g	-	-	0.22	0.90
Gooseberry (Indian) 15.00g	-		-	-
Ginger raw, fresh 5.00g	4.43	0.20	0.01	1.28

Table 4 **FAT SOUBLE VITAMINS**

Food items	Nutrients :	Vitamin A (IU or mcg)	Vitamin D (mcg)	Vitamin E (mg)	Vitamin K (mcg)
Arrowroot flour 19.00g		-	-	-	-
Egg white, Raw 80.00g		0.00	0.00	0.00	0.00
TOTAL		55.23 (B. Carot.)	14.99	3.43	17.12
TOTALS (in% of daily requirement) Remarks: (' - ') - Not detectable in the mentioned qty.)*Stored nutrient Bold - adequate [21]		i.e.,*27.84% (Total Vit. A 250.60mcg)	*100.00%	*22.87%	*14.27%

Table 4 **WATER SOLUBLE VITAMINS**

Food items	Nutrients	Thiamin (B1) (mg)	Riboflavin (B2) (mg)	Niacin (B3) (mg)	Pyridoxine (B6) (mg)	Pantothenic acid (B5) mg)	Folate (B9) (mcg)	Vitamin B12 (mcg)	Vitamin C (mg)
From the cereals – pulse combination		1.16	0.52	6.46	0.77	4.21	200.00	0.67	2.40
Milk 250.00g (excluding added vit. D)		0.15	0.45	0.30	0.10	1.00	12.50	1.13	0.00
Fenugreek seeds 12.50g		0.04	0.02	0.15	0.10	0.03	6.39	0.00	0.00
Sunflower oil 4.50g		-	-	-	-	-	-	-	-
Flaxseed 7.50g (3.75 tsp. pwdr)		0.08	0.01	0.15	0.02	0.05	4.35	-	0.03
Olive oil 1.50g		-	-	-	-	-	-	-	-
Gooseberry (Indian) 15.00g		0.00	0.00	0.05	-	-	-	0.00	90.00
Ginger raw, fresh 5.00g		0.00	0.00	0.02	0.01	0.01	0.54	0.00	0.27
Arrowroot flour 19.00g		-	-	-	0.00	0.02	1.33	-	-
Egg white, Raw 80.00g		0.00	0.37	0.09	0.01	0.16	3.40	0.08	0.00
TOTAL		1.47	1.35	7.30	1.02	5.49	230.49	1.87	92.72
TOTALS (in% of daily requirement) Remarks: (' - ') - Not detectable in the mentioned qty.) Bold - adequate [21]		122.50%	103.85%	45.63%	78.46%	109.80%	57.62%	77.92% Stored nutrient	103.02%

Table 4 **MINERALS & TRACE ELEMENTS**

Food items	Nutrients:	Calcium (mg)	Phosphorus (mg)	Magnesium (mg)	*Sodium (mg)	Potassium (mg)	Iron (mg)	Iodine (mcg)	Fluoride (mg)	Zinc (mg)	Copper (mcg)	*Chromium (mcg)*	Selenium (mcg)	*Molybdenum (mcg)*	Manganese (mg)	*Chloride (g)
From the cereals – pulse combination		133.96	1069.48	191.95	31.19	1665.52	9.53	-	-	7.60	1708.80	*11.10*	86.98	*212.10*	5.75	-
Milk 250.00g (excluding added vit. D)		282.50	210.00	25.00	107.50	330.00	0.10	0.00	0.00	0.95	62.50	*10.00*	9.50	-	0.00	-
Fenugreek seeds 12.50g		16.88	54.38	20.88	5.03	111.38	1.05	0.00	0.00	0.48	145.00	*1.88*	1.25	*12.25*	0.20	-
Sunflower oil 4.50g		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Flaxseed 7.50g		12.75	32.10	19.60	1.50	40.65	0.29	0.00	0.00	0.22	61.00	*0.05*	1.27	*1.10*	0.12	-

Table 4 **MINERALS & TRACE ELEMENTS**

Food items	Nutrients:	Calcium (mg)	Phosphorus (mg)	Magnesium (mg)	*Sodium (mg)	Potassium (mg)	Iron (mg)	Iodine (mcg)	Fluoride (mg)	Zinc (mg)	Copper (mcg)	*Chromium (mcg)*	Selenium (mcg)	*Molybdenum (mcg)*	Manganese (mg)	*Chloride (g)
(3.00 tsp. pwdr)																
Olive oil 1.50g		0.02	-	-	0.00	0.02	0.01	-	-	-	-	-	-	-	-	-
Gooseberry (Indian) 15.00g		7.50	-	-	0.75	33.75	0.18	_	_	-	-	_	-	_	-	_
Ginger raw, fresh 5.00g		0.94	2.22	2.73	0.50	20.35	0.10	_	_	0.02	6.50	*0.65*	-	*0.10*	0.19	__
Arrowroot flour 19.00g		7.60	0.95	0.57	0.38	2.09	0.06	-	-	0.01	7.60	-	-	-	0.09	-
Egg white, Raw 80.00g		5.95	12.75	9.35	141.10	138.55	0.07	-	-	0.03	17.00	-	17.00	-	0.01	-
TOTAL		471.88	1397.28	279.33	280.40	2354.49	11.52	-	-	9.41	2037.90	*23.71*	115.64	*226.10*	6.43	-
TOTALS (in% of daily requirement) Remarks: (' - ') - Not detectable in the mentioned qty.) *4.40g NaCl proides adq. amount. Bold - adequate [21]		47.1 9%	199.61%	69.83%	18.69%	69.25%	144.00%	Tissue stored nutrient.	Adequate water levels in India	85.54%	226.40%	*67.74%*	210.25%	*502.44%*	279.56%	

Table 4 **ESSENTIAL AMINO ACIDS (ADULT MALE – 70.00kg)**

Food items	Nutrients :	Histidine (mg)	Isoleucine (mg)	Leucine (mg)	Lysine (mg)	*Methionine (mg)	**Phenylalanine (mg)	Tyrosine (mg)	Threonine (mg)	Tryptophan (mg)	Valine (mg)
From the cereals – pulse combination		1207.29	2041.95	3774.85	2401.68	830.88	2654.74	1642.46	1632.43	583.84	2696.06
Milk 250.00g (excluding added vit. D)		237.50	407.50	747.50	660.00	207.50	407.50	397.50	335.00	100.00	515.00
Fenugreek seeds 12.50g		72.40	145.16	190.58	209.63	39.70	131.23	81.63	90.52	37.80	140.71
Sunflower oil 4.50g		-	-	-	-	-	-	-	-	-	-
Flaxseed 7.50g (3.00 tsp. pwdr)		23.60	44.80	62.00	43.10	18.50	47.85	24.65	38.30	14.85	53.50
Olive oil 1.50g		-	-	-	-	-	-	-	-	-	-
Gooseberry (Indian) 15.00g		-	-	-	-	-	-	-	-	-	-
Ginger raw, fresh 5.00g		1.75	4.42	7.20	2.56	0.99	4.83	4.20	4.79	1.10	4.83
Arrowroot flour 19.00g		0.76	1.90	3.61	2.47	1.14	2.28	1.71	2.28	0.76	2.66
Egg white, Raw 80.00g		246.50	561.85	863.60	685.10	339.15	583.10	388.45	381.65	106.25	687.65
TOTAL		1787.10	3196.	5629.54	3985.79	1427.	3221.16	2530.08	2478.97	845.7	4086.71

Table 4 **ESSENTIAL AMINO ACIDS (ADULT MALE – 70.00kg)**

Food items	Nutrients :	Histidine (mg)	Isoleucine (mg)	Leucine (mg)	Lysine (mg)	*Methionine (mg)	**Phenylalanine (mg)	Tyrosine (mg)	Threonine (mg)	Tryptophan (mg)	Valine (mg)
			93			16				8	
TOTALS (in% of daily requirement) Remarks: (' - ') - Not detectable in the mentioned qty.) *With cysteine ER-1050.00: adequate ** With tyrosine ER-1750.00: adequate Bold – Adequate [20]		255.30 %	228.35%	206.21 %	189.80 %	135.92%	328.64%		236.09 %	302.06%	224.54 %

3. Results

Thus the new menu formulation is appropriate in proximate principles, adequate in all essential amino acids, most of the minerals and vitamins, but partially deficient in a few protective nutrients (table 4) [20, 21]. Still adequate level of the vitamin critically important for guarding the normal heart health (thiamin/vit. B1), is of mentionable significance.

4. Discussion

Though the new menu is calorically adequate and nutritively supportive to the context, from the clinical management point of view, its deficiencies are the prime points to be discussed at first-especially the mineral deficiencies. This is because, at least four of them are therapeutically important electrolytes too (potassium, magnesium, calcium, and sodium). Out of these, deficiency of the first three can seriously trouble the heart and also can interfere with the ECG records, while sodium deficiency can seriously harm the acid-base balance. The reason for the potassium deficiency in the menu (by 31.00%) is omission of green leafy vegetables from the protective food items, as an attempt to reduce the bulkiness of the diet. Zinc and chromium are the other two partially deficient minerals in the menu (deficiency of 14.00% and 32.00%, respectively).

The next priority has to be given to the deficiencies of non -stored vitamins – niacin, pyridoxine and folate (54.00%, 22.00% and 42.00% deficiency, respectively), because their partial deficiencies even for a few days can result in serious adverse metabolic alterations.

A, E, K and the B 12 vitamins are the stored vitamins with partial deficiencies in the new menu formulation (72.00%, 77.00%, 86.00% and 22.00%, respectively). The provision of last priority to this category, is based on the expectation of normal body storage backup. But for any one with features of malnourishment, priority should be given for these also, with the non-stored vitamins. The fiber deficiency and vitamin K deficiency share the same reason behind potassium deficiency, in the menu.

The Ethical Approach to the Partial Nutrient Deficiencies

In the case of any patient under continuous therapeutic care, the clinician has to expect, asses and actively interfere with the partial deficiencies mentioned above, on giving him diet based on the new menu.

In the deficiency issue of stored vitamins, oral or parenteral supplementation of the deficient ones, at least on three non-consecutive days in a week will be remedial, whereas daily supplementation will be necessary for the non-stored vitamins. Care should be taken to use formulations (vitamin capsules, tablets, powders, syrups, nutraceuticals or infusions) with optimal nutrient contents for avoiding the complications from overdose toxicities; in the case of fluid forms or powders, the amount of water ingestion also may have to be counted for. For parenteral infusions, their tonicity (osmotic strength) is another matter to be listened to.

But healthful and safe electrolyte supplementation by any route requires their periodic serum level estimations for confirming the normal levels, because of their sudden influences on the total condition of the person and his heart. Among these the potassium and magnesium deficiencies deserve the topmost priority, especially in the setting of digoxin treatment, for the failure.

Corresponding to the total calorie reduction (from 2000.00), the dietary fiber level also shows some reduction (from the daily target level of 38.00g). But, on considering the inconveniences from abdominal discomforts and increased bowel movements in bed ridden persons parallelling with higher fiber consumption, it is better to view the 10.00% deficiency

here, as 90.00% sufficiency, and thereby avoiding any further supplementation.

Iodine and fluoride are yet another set of stored nutrients with complete deficiency, in the new menu. Since the iodine content of vegetarian and non-marine food items largely depends on the geographically variable iodine levels of the cultivation lands (depending on the sea proximity) and fluoride content on the fluoride levels of irrigating water of the locality, nutritive data with generalized applicability are not available for both of the nutrients and hence, quantitative adequacy of both in the vegetarian – nonmarine menu combinations cannot be predicted. So either inclusion of some sea products in diet or appropriate use of iodized salts are the two easily adoptable methods for solving the iodine inadequacy, via the dietary route.

Availability of fluoride is primarily expected through the drinking water, rather than from food items. As a matter of fact, in most parts of India, the fluoride content of drinking water is about 0.50mg/L which is optimal for preventing manifestations of fluoride deficiency, due to the habit of higher water intake common to the tropical countries [22]. But according to the contextual requirements of the patient under care, these two also should be supplemented, as per the clinical and laboratory data assessments. A similar policy can be adopted for tackling the chloride deficiency too, though dietary supplementation is possible by allowing the patient to take the permissible daily minimal quota of table salt (4.40g/day or 75.00meq) [23].

The matter of two protective nutrients – chromium and molybdenum – deserve special mention here, because of a separate data source, since the earlier mentioned sources did not provide the required data [24]. According to this source the current menu combination provides both the nutrients adequately, well below their TULs.

Though the workup constitutes a model menu combination with mathematically predicted nutritional properties, can provide the essential guiding gridwork for preparing other metabolically targeted dietetic models for clinical evaluation quite easily. This will help in cutting short of wastages in materials, time and other resources associated with clinical trials of random dietetic models in various diseases, to the minimum. Since being a derivative formulation of already well accepted models (the TM and ADA models), just substituted with some nutritively equivalent Indian traditional food items in near traditional quantities, the clinical evaluation of the formulation for its therapeutic usefulness, will be quite simpler too. Both the methodology of the formulation mentioned and its interim evaluation tables are, nutritive assessment tools too, for the traditional as well as new dietetic formulations, before and after preparing recipes.

5. Conclusions

The authors' attempt shows that, it is possible to propose a model menu combination in simple tabular form for a relatively less bulky and reasonably nutritious diet of 1550.00 Calories suitable for feeding diabetic persons under intensive clinical care for heart failure, with an added benefit of providing fat in the classic format, with specific quantities of certain locally available food items routinely used by the Indians.

The general method of proposal formulation was to start with the assessment of inherent carbohydrate and protein deficits of the modified cereals - pulse combination taken for a day's 1062.80 Calories *from carbohydrate and protein* (68.57% of 1550.00), and then to constitute the fat combination as mentioned above, followed by nominal addition of protective food items - without overfilling those deficits by the carbohydrate and protein moieties of the latter additions.

Transmitting the knowledge on various aspects of formulating metabolically targeted diets combining local food items with low and medium glycemic indices to the health care personnel of India, will enable them to provide the health benefits of effective enteral nourishment for diabetic HF patients under rest, with lesser budgetary load than on using the costly parenteral nutrition preparations.

A critical point on the new menu formulation is, regarding the Glycemic indices of the food items. Out of the 15 constituent food items only two have index values over 55 (wheat - 68, arrowroot flour - 65). But on consuming admixed with other components of an almost fiber sufficient diet (around 90.00% of the daily target), the sudden blood sugar peaking effect of these high indexed foods will be blunted further and hence, composition of the menu formulation mentioned over is a totally favorable one to the overall wellbeing of a diabetic Indian adult with HF, under restful clinical care.

Abbreviations

HF	Heart Failure
TM	Traditional Mediterranean Diet
ADA	American Diabetes Association
SAFA	Saturated Fatty Acid
MUFA	Mono Unsaturated Fatty Acid
PUFA	Poly Unsaturated Fatty Acid
TULs	Tolerable Upper Levels

Supplementary Material

The supplementary material can be accessed at https://doi.org/10.11648/j.ccr.20250902.16

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Author Contributions

Vasudevan Sankaran: Methodology
Vasudevan Damodaran: Conceptualization
Jabbar Puthiyaveettil: Validation
Rajesh Ravi: Resources, Project administration

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The study was fully under the exchequer of the authors, from the beginning to completion.

Data Availability Statement

The data supporting the outcome of this research work has been reported in this manuscript.

Conflicts of Interest

The authors declare no conflicts of interest.

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Biography

Vasudevan Sankaran is a pathologist and Assistant Professor of Pathology at the Government Medical College, Thrissur, located in the South Indian state of Kerala. Received M. B. B. S (1991) and MD (Pathology - 2012) degree from the same college. Since 1996 teaches UG and PG medical students, in the same college. Formerly in early nineties, was working under Dr. Vasudevan M. Damodaran, in his research team. Clinical nutrition is one of his field of interest, and has written many popular science articles and books (a total of around 30) on various medical subjects.

Vasudevan Damodaran is a physician biochemist and research director, Jubilee Medical College and Research centre, Thrissur, Kerala, South India, and also Associate Dean of Research, Amrita Institute of Medical Sciences, Kochi, Kerala, South India. After completing M. B. B. S, received MD in Biochemistry from All India Institute of Medical Sciences in 1971. Subsequently, became a Fellow of the Royal College of Pathologists in 1994. Was the Principal of different medical colleges (Amrita School of Medicine, Kochi, Kerala; Sikkim Manipal Institute of Medical Sciences, Gangtok, Sikkim). Currently a Fellow of the National Academy of Medical Sciences (FAMS) and Fellow of the Association of Clinical Biochemists (FACBI). Recipient of the prestigious "BC Roy National Award for eminent medical teacher" received from the then President of India in 1994. Has published more than 250 research papers in peer reviewed journals. Already 35 students have taken PhD under Dr. Vasudevan Damodaran's guidance.

Jabbar Puthiyaveettil is a clinical endocrinology professor and an Additional Director at the Indian Institute of Diabetes, Trivandrum – South India. He completed his MBBS from Govt. Medical College, Trichur in 1990, Diplomate of National Board (Medicine) in 1995, MD (General Medicine) from Govt. Medical College Kottayam in 1994, DM (Endocrinology) from G S Medical College & KEM Hospital in 1997 and Diplomate of National Board - Endocrinology from the Indian National Board of Examinations, in 1998. He established the first department of academic Endocrinology in government sector - in the state of Kerala. He has numerous publications in national and international journals.

Rajesh Ravi, a holder of postgraduate degree in General medicine, is an Associate professor at the Government Medical College, Thrissur, located in the South Indian state of Kerala. He is a passionate clinician and has published many scientific articles, mainly in Hepatology.

Research Field

Vasudevan Sankaran: Nutrition biology, Nutritional disorders, Designing metabolically targeted diets for clinical trials in various conditions of health and disease, with locally available food items, Metabolic alterations in malnourishment.

Vasudevan Damodaran: Nutrition biology, Nutritional disorders, Cancer cell metabolism, Metabolic alterations in health and diseases, Life style diseases.

Jabbar Puthiyaveettil: Endocrine diseases, Endocrine alterations and solutions in medical, obstetric and surgical conditions, Clinical trials of diet models and Hepatology.

Rajesh Ravi: Infectious diseases, Neurologic alterations in viral diseases, Cardiology, Critical care and Hepatology.