Therapeutic Diets for the Management of Diabetes and Arthritis among Adults using Selected Indigenous Foods as Recipes in Aluu Community, Rivers State

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ABSTRACT
Background: *In the prevention and management of chronic diseases, intake of a healthy and adequate indigenous diets are found to be essential hence the need for them to be prioritized.*
Objective: *This study prepared diets intended for the management of diseases such as diabetes and arthritis, from developed recipes using selected indigenous foods and evaluated their nutrient compositions.*
Methods*: Ten diets namely: sweet potatoes vegetable pudding (SPV), fried tapioca salad (FTS), vigna pottage delicacy (VPD), steamed whole cowpea (SWC), pleurotus wheatmix flakes (PWF), corn garden egg pudding (CGP), papaya fruit salad (PFS), savory star ginger fruitveg drink (SGF), pumpkin squash cucumber salad (PSC) and avocado cucumber salad (ACS) were prepared from developed recipes. AOAC analytical methods were used in determining the nutrient compositions. Sensory characteristics were done using the nine point hedonic scales by 12 trained panelists. One way analysis of variance was used for data analysis.*
Results*: The diets from developed recipes contained appreciable amount of nutrients especially vitamin C, fiber and protein with PWF having the highest contents of fibre (1.68g/100g) and vitamin C (68.15mg/100g). With reference to protein, SWC diet had the highest content (1.80g/100g). VPD had the highest content of vitamin E (7.80mg/100g) and calcium (2.66mg/100g). The carbohydrate (2.30-20.05g/100g) and fat (0.35-4.41g/100g) contents of the diets were low. The result also showed that SWC has got highest acceptance by all sensory parameters except for its aroma.*
Conclusion*: The therapeutic diets developed and analysed in this study contained appreciable amount of nutrients especially vitamin C, fiber and protein. A well combined indigenous foods could be used for the management of diseases such as diabetes and arthritis and for improvement of general nutritional status.*

Keywords: Therapeutic diet, diabetes, arthritis, wellbeing.

INTRODUCTION

Diabetic individuals have high rates of micronutrient deficiencies. [1]. The risk of type 2 diabetes is increased by 4-fold in obese patients [2]. Diabetes is a chronic disease that occurs either when the pancreas does not produce enough insulin or when the body cannot effectively use the insulin it produces [3]. Hyperglycaemia, or raised blood sugar, is a

common negative effect of uncontrolled diabetes and over time leads to serious damage to many of the body's systems, especially the nerves and blood vessels [3]. Type 2 diabetes also known as non-insulin dependent accounts for about 90 - 95% of all cases of diabetes around the world [4]. The current prevalence of diabetes in Nigeria is estimated to be between 8 - 10% [4]. According to the World Health Organisation(WHO), diabetes will be the 7th leading cause of death by in 2030 [5]. More than 80% of diabetes deaths occur in low- and middle-income countries. Diet plays a major role in diabetes prevention and management, improving the overall health by achieving and maintaining optimal nutritional status, attaining good glycemic control and preventing acute and long term complications of diabetes mellitus[6].

Arthritis is an inflammation of the joints. It can affect one joint or multiple joints. It is most common in adults over the age of 65, but can also develop in children, teens, and younger adults [7]. Arthritis is more common in women than men and in people who are overweight [7]. . There are more than 100 different types of arthritis with the commonest being rheumatoid arthritis (RA) [7]. A recent Nigerian study reported 12.3% of all patients seen in rheumatology[8]. Food plays an important role in managing inflammation [9]. Foods are known to play crucial role in keeping a check on the diseases or the risk of developing certain diseases[10]. Therapeutic diet majorly focuses on natural unprocessed whole foods that help boost overall health and stave off the risk of various diseases. The diet is planned in a way that it is nutritionally balanced and sustainable. The different foods included were indigenous foods that are consumed as a common food in a typical diet for both their nutritive value and health benefits. The foods have previously reported scientific evidence validating their ethnomedicinal use(s)[9-17]. The foods focused are roots and tubers, legumes and seeds, cereal grains, fruits and vegetables and were used to develop recipes and prepare diets intended for the management of diabetes, arthritis and general good nutritional status. The health benefits of these foods as previously reported includes: Turmeric has antioxidant, anti-inflammatory and anticarcinogenic properties [11], Garlic has low density lipoprotein (LDL) cholesterol lowering effects while increasing high density lipoprotein (HDL) levels and antihypertensive effects [12]. Fruits and vegetables are also considered by FAO and WHO as the primary nutritional tools to prevent non-communicable and micronutrient deficiency related diseases [13]. Type 2 diabetes, obesity, cancer and certain cardiovascular diseases can be significantly reduced through increased consumption of fruits and vegetables [13]. Ginger has anti-inflammatory property and reduces arthritis pain [9]. Sweet potatoes can help regulate blood glucose, contains antioxidants [14]. Eating whole grains is associated with various benefits, including a lower risk of diabetes, heart disease, and high blood pressure [15]. Mushroom has antioxidant and antimicrobial properties [16]. A study by [17], revealed that date palm fruits may be of benefit in glycaemic control in non-diabetics. Specifically, the study prepared diets from developed recipes using indigenous foods that could be used for the management of diseases such as diabetes and arthritis, determined the nutrient contents and sensory evaluation of these diets. The developed diets will improve the nutritional status and enhance the physiological needs especially the micronutrient needs of individuals, diabetics and arthritic patients. The information will guide Dietitians and Nutritionists in recommending the most suitable diets for patients especially individuals with diabetes and arthritis. The study will also generate information that will be useful to medical personnel in educating the general public on nutritive values of most indigenous foods for improved nutritional status.

MATERIALS AND METHODS

Study design and location

This study design was experimental research and was conducted in Aluu, Rivers State, Nigeria.

Method of data collection

The method of data collection includes nutrient and sensory evaluation of ten therapeutic diets prepared from developed recipes which are: sweet potatoes vegetable pudding, fried tapioca salad, vigna pottage delicacy, delicious steamed whole cowpea, pleurotus wheat mix flakes, corn garden egg pudding, papaya fruit salad, savory star ginger fruitveg drink, pumpkin squash cucumber salad and delicious avocado cucumber salad.

Purchase of ingredients and processing of samples

The different ingredients: sweet potatoes, brown

beans, corn, whole wheat, mushroom (*Pleurotus tuber regium*), cucumber, carrots, green beans, avocado pear, African spinach, garden egg leaf, fresh tomatoes, water melon, date Palm (*Phoenix dactylifera*) fruit, fresh pepper, onions, ginger, garlic, turmeric, salt palm oil and vegetable oil were purchased at Choba market, Port Harcourt, Rivers state, while bambara groundnut seed was procured at Ogbete market, Enugu and processed into flour. Cassava tubers were harvested from a farm in Omuokiri-Aluu and processed into cassava dried flakes. Reported methods were used to processed the cassava tuber[18], whole wheat[19], date palm fruits[20] and mushroom (*Pleurotus tuber reguim*)[21].The ginger was washed, peeled, sliced into smaller bits and oven dried at 200°c for 10 minutes.

Developed recipe from roots and tubers, legume and seeds, cereal grains, fruits and vegetables for therapeutic diets preparation

1.] Sweet potatoe vegetable pudding(SPV): Sweet potatoes(125g), carrot(½ medium size), green beans(3 sticks), egg(1), fresh ground pepper(1 teaspoon), onion bulb(1), ground fresh ginger(¼ teaspoon), ground turmeric(¼ teaspoon), ground garlic(¼ teaspoon), fresh tomatoes(1 small size), seasoning(¼ cube), salt(a pinch) and vegetable oil(1 tablespoon or 15ml).

Preparation: The sweet potatoes was washed, peeled and cut into small sizes and shapes, and set aside. The vegetables were washed and cut into small sizes and shapes, the vegetables were added to sweet potato chunk, salt and seasoning were added to taste, The beaten egg was added, the vegetable oil was added and mixed properly. The mix was scooped into silicon cups and placed in a pot, little water was added to the pot and steamed for 30 minutes adding water as needed(1 serving).

2. Fried Tapioca salad(FTS): Cassava flakes(100g), stock fish flakes(25g, egg(1 medium size), carrot(¼ medium size), cabbage(1/8 small size), green pepper(¼ small size), onion bulb(1 small size), garden egg(1 piece), green beans(2 sticks), ground fresh ginger(¼ teaspoon), ground turmeric(¼ teaspoon), ground garlic(¼ teaspoon), fresh tomatoes(1 small size), seasoning(¼ cube), salt(a pinch) and vegetable oil(1 tablespoon or 15ml).

Preparation: The cassava flakes was blanched and the water was drained immediately using a colander, the stockfish flakes was boiled for 20 minutes and set aside for later use, the vegetables were washed and cut as desired, the vegetable oil was put on heat for few seconds, the vegetables were added to it and fried for 3 minutes, salt and seasoning to taste were added, the already beaten egg was added and allowed to simmer for 2 minutes before stirring, the cassava flakes was added and mixed properly, top with sliced onions and garden egg(1 serving).

3 Vigna pottage delicacy(VPD): Bambara groundnut flour(50g), garden egg(3 leaves), cucumber(1/3 small size), African spinach(5 leaves), fresh ground pepper(1 teaspoon), onion bulb(1), ground fresh ginger(¼ teaspoon), ground turmeric(¼ teaspoon), ground garlic(¼ teaspoon), fresh tomatoes(1 small size), salt(a pinch), palm oil(1 tablespoon or 15ml), Water (195mls).

Preparation: The vegetables were picked, washed and sliced/chopped into desired shapes and sizes, bambara groundnut flour was mixed with 120mls of water, a pinch of salt was added, the mixed sample was wrapped with foil paper, steamed for about 40 to 45 minutes with an intense heat, the steamed bambara groundnut was sliced into cubes and put in a cooking pot, all the prepared ingredients were added with 75mls of water excluding garden egg leaf and cucumber and mixed properly, the mix was put on heat for 3 to 5 minutes depending on the nature of cooking heat, the garden egg and cucumber were added after removing from heat and mixed properly(1 serving).

4. Steamed whole cowpea(SWC): Brown beans(¼ cup), dried fish(25g), crayfish(½ tablespoon), ground fresh ginger(¼ teaspoon), ground turmeric(¼ teaspoon), ground garlic(¼ teaspoon), fresh tomatoes(1 small size), carrot(¼ medium size), onion bulb(1 small size), cucumber(¼ small size), cayenne pepper(1 small size), nutmeg(¼ teaspoon), seasoning(¼ cube), salt(a pinch), vegetable oil(1 tablespoon or 15ml) and water(160ml).

Preparation: The beans was sort and washed without removing the skin, the dried fish was

cleaned and deboned, the vegetables were washed and sliced and set aside for later use, the washed whole beans was blend with cayenne pepper, crayfish, onion and water until the paste was very smooth, the paste was poured into a bowl, the paste was spiced, vegetable oil added and stirred properly, the dried fish was added, the mix was scooped into silicon cup and placed in a pot, little water was added to the pot and steamed for 30 minutes adding water as needed, after 25 minutes, it was topped with sliced carrot, cucumber and fresh tomatoes(1 serving).

5. Pleurotus wheatmix flake(PWF): Whole wheat(50g), *Pleurotus tuber reguim* mushroom(17g), date palm fruit(9g), ginger(a tiny piece) and water(225ml).

Preparation: The already processed whole wheat seeds, pleurotus tuber regium(mushroom), date palm pulp and ginger were mixed, the mixed ingredients were ground with an attrition mill, put in a pot, add 225mls of water was added, stirred and cooked for 5 minutes(1 serving).

6. Preparation of Corn garden egg pudding(CGP): Dried corn(¼ cup), dried fish(25g), crayfish(1 tablespoon), garden egg(2), ground fresh pepper(½ teaspoon), African spinach(5 leaves), fresh ginger(1 small size), ground turmeric(¼ teaspoon), ground garlic(¼ teaspoon), onion bulb(1 small size), seasoning (¼ cube), salt(a pinch), palm oil(1 tablespoon or 15mls), water(250ml) and foil paper.

Preparation: The corn was washed and soaked for 15 minutes, the smoked fish was cleaned and deboned, vegetables were washed and set aside for later use, the soaked corn was blended with fresh pepper, crayfish, onions and water until the paste was coarse (rough) in texture, not very smooth. the paste was poured into a bowl, salt, seasoning and palm oil was added and stirred properly, the vegetables were added and stirred, the fish was added, the mix was scooped into foil bag and placed in a pot, little water was added to the pot and steamed for 40 minutes adding water as needed(1 '

7. Papaya fruit salad(PFS): pawpaw(1/8 medium size), watermelon(1/8 medium size) and banana(1 finger).

Preparation: Fruits were washed and peeled, the seeds of the watermelon and pawpaw was removed, the fruits were cut into desired shapes and sizes, the fruits were mixed properly(1 serving).

8. Savory Star ginger fruitveg drink(SGF): African star apple(1 medium size), banana(½ finger), ginger(¼ teaspoon), carrot(1 medium size), orange(1 medium size) and water(100ml).

Preparation: Carrot vegetable was washed and cut into small shapes, the african star apple, banana and orange fruits were washed, peeled, the cherry and orange seeds were removed and the fruits cut into small sizes, the vegetable and fruit chunk were put in a blender jar, 150mls water was added, all ingredients were blend to a smooth pureed consistency(1 serving).

9. Pumpkin squash cucumber salad(PSC): fluted pumpkin squash(½ medium size), fluted pumpkin(1 broad leaf), cucumber(½ medium size), nutmeg(¼ teaspoon) and water(45ml)

Preparation: Fluted Pumpkin squash was washed, peeled, seeds were removed and it was cut into desired shapes and sizes, fluted pumpkin leaf and cucumber vegetables were washed and cut into desired shapes and sizes, the fluted pumpkin squash was cooked for 5 minutes with 45mls water, fluted pumpkin leaf and cucumber were added and properly mixed, nutmeg was added and covered for 2 minutes to simmer(1 serving).

10 Avocado cucumber salad(ACS): Cucumber(1 small size), avocado pear(½ of small size) and watermelon(1/8 medium size).

Preparation: Vegetable and fruits were washed and cut into desired shapes and sizes and then mixed properly(1 serving).

Nutrient analysis of the prepared therapeutic diets

The crude protein(Cp), fat(F), moisture(M), ash(A) and crude fibre(Cf) contents of the foods were determined according to the AOAC method[22]. The total carbohydrate(TC) content was obtained by difference[23]. This involved subtracting the sum of percentage of Cp, F, A, Cf and M from 100. The Energy of food was obtained by multiplying the percentage Cp, F and TC with their respective appropriate Atwater factor of 4, 9 and

4/Kcal/100g weight of sample and adding up to obtain the caloric value as reported[24]. Determination of Calcium and Chromium was conducted using the flame Atomic Absorption Spectrophotometer[25]. Vitamin C and E contents were determined as reported by[26].

Sensory evaluation

The sensory evaluation of this study was done as reported by[27]. The nine (9) point hedonic scale was used to evaluate the sensory characteristics of the prepared diets where 9 represented like extremely, 8 represented like very much, 7 represented like moderately, 6 represented like slightly, 5 represented neither like nor dislike, 4 represented dislike slightly, 3 represented dislike moderately, 2 represented dislike very much and 1 represented dislike extremely. 12 trained panelists from the Department of Pharmacognosy and Phytotherapy of the University of Port Harcourt, Rivers State, evaluated the sensory properties based on colour, texture, taste, aroma and overall acceptability.

Data analysis technique

Data collected are expressed as mean± standard deviation. One way analysis of variance (p=0.5) was used to test for significance.

RESULTS:

Table 1 shows the proximate composition of the diets from developed recipes. The moisture content of the diets ranged from 73.97±0.52g to 95.37±0.16g. ACS(95.37±0.16g) was significantly higher (P<0.05) compared to other diets. The fat content ranged from 0.35±0.05g to 4.41±0.19g. SWC(4.41±0.19g), SPV(4.37±0.07g) and VPD(4.26±0.10g) were significantly higher than other diets (P<0.05). Protein content ranged from 0.34±0.03g to 1.80±0.08g. SWC(1.80±0.08g) and PWF(1.51±0.07g) were higher significantly higher (P<0.05) compared to other diets followed by FTS(1.18±0.08g), CGP(1.18±0.06g), VPD(1.08±0.02g) and SPV(1.07±0.04g). The ash content of the diets differed significantly (P<0.05), VPD (1.85±0.20g) had the highest value followed by CGP(1.45±0.25g) and SWC(1.11±0.27g). Crude fibre content of the diets ranged from 0.05±0.00g to 1.68±0.03g. PWF(1.68±0.03g) contained the highest crude fibre followed by VPD(1.42±0.12g) and the crude fiber contents differed significantly (P<0.05). The carbohydrate content ranged from 2.30±0.43g to 20.05±1.04g. FTS(20.05±1.04g) was significantly (P<0.05) higher compared to other diets followed by CGP(19.61±1.23g), PWF(18.20±2.94g), SWC(15.92±1.27g), SPV(14.11±1.11g) and VPD(13.42±0.63g). The energy values of the diets ranged from 20.45±3.89 to 116.87±5.84g. FTS(116.87±5.84g) had the highest energy content followed by CGP(116.19±6.97g), SWC(110.48±8.84g) and SPV(100.05±8.00g). ACS(20.45±3.89g) had the least energy value. The energy contents of the diets differed significantly (P<0.05).

Table 2 shows the vitamins and minerals composition of the diets from developed recipes. Vitamin C content of the diets ranged from 7.52±0.08mg to 68.15±0.16mg and there was significant difference between the diets (P<0.05). PWF(68.15±0.16mg) had the highest value of vitamin C followed by SGF(38.11±0.16mg), FTS(36.66±0.08mg), SPV(34.38±0.08mg), PFS(33.16±0.32mg) and ACS(31.58±0.08mg) while PSC(7.52±0.08mg) had the least value of Vitamin C content. The vitamin E content ranged from 0.08±0.00mg to 7.80±0.08mg. There was significant difference between the diets (P<0.05). VPD(7.80±0.08mg) had the highest value followed by FTS(5.33±0.00mg). SWC(2.30±0.01mg) and SPV(2.08±0.00mg) ranked third while PFS(0.08±0.01mg) had the least value. Calcium content of the dishes ranged from 0.01±0.00mg to 2.66±0.18mg. Nevertheless, only eight diets recorded calcium contents and they were significantly different (P<0.05). VPD(2.66±0.18mg) and PWF(2.39±0.05mg) had the highest value. The diets that recorded chromium contents were SWC(0.02±0.01mg), SPV(0.02±0.00mg) and PFS(0.02±0.00mg) and is almost within the same range. There is a significant different between the diets in terms of chromium content (p<0.05).

Table 3 shows the sensory properties of the diets from developed recipes. The colour of the diets differed significantly (P<0.05). It ranged from 5.75±1.28 to 8.75±0.46. The colour of SWC(8.75±0.46) was preferred most compared to other diets. The diet produced from PFS(8.5±1.07) had highest value for aroma and was significantly (P<0.05) different from other diets. The taste of the diets ranged from 5±2.40 to 8.25±0.89. SWC(8.25±0.89) was significantly (P<0.05) higher in taste compared to other diets.

Plate 1:SPV diet

Plate 2:FTS diet

Plate 3: VPD diet

Plate 4:SWC diet

Plate 5:PWF diet

Plate 6:CGP diet

Plate7:PFS diet

Plate 8:SGF diet

Plate 9: PSC diet

Plate10:ACS diet

Figure 1:

Figure 1: One serving each of the ten prepared therapeutic diets

Table 1: Proximate composition of the diets from developed recipes

Diet	Proximate Composition						
	Energy (Kcal)	Carbohydrate (g/100g)	Protein (g/100g)	Fat (g/100g)	Crude fiber (g/100g)	Ash (g/100g)	Moisture (g/100g)
SPV	100.05±8.00	14.11±1.11	1.07±0.04	4.37±0.07	0.53±0.01	0.86±0.13	79.06±1.96
FTS	116.87±5.84	20.05±1.04	1.18±0.08	3.55±0.22	0.11±0.01	0.97±0.04	74.14±0.98
VPD	96.34±4.82	13.42±0.63	1.08±0.02	4.26±0.10	1.42±0.12	1.85±0.20	77.96±0.30
SWC	110.48±8.84	15.92±1.27	1.80±0.08	4.41±0.19	0.09±0.00	1.11±0.27	76.67±4.68
PWF	88.47±5.31	18.20±2.94	1.51±0.07	1.07±0.38	1.68±0.03	0.19±0.13	77.35±1.91
CGP	116.19±6.97	19.61±1.23	1.18±0.06	3.67±0.22	0.12±0.00	1.45±0.25	73.97±0.52
PFS	29.27±1.76	6.07±0.38	0.46±0.01	0.35±0.05	0.05±0.00	0.39±0.17	92.68±0.50
SGF	28.70±1.15	5.47±0.23	0.40±0.03	0.58±0.02	0.26±0.01	0.24±0.12	93.05±1.42
PSC	28.75±1.15	5.52±0.19	0.34±0.03	0.59±0.03	0.32±0.01	0.62±0.00	92.61±0.11
ACS	20.45±3.89	2.30±0.43	0.45±0.25	1.05±0.03	0.41±0.02	0.42±0.04	95.37±0.16

Mean ± Standard deviation of three determinations. Mean values in the same rows are significantly different ($P<0.05$).

Key to Table 1:

SPV=Sweet potatoe vegetable pudding, FTS=Fried tapioca salad, VPD =Vigna pottage delicacy, SWC=Steamed whole cowpea, PWF=Pleurotus wheatmix flakes, CGP=Corn garden egg pudding, PFS=Papaya fruit salad, SGF=Star ginger fruitveg drink, PSC=Pumpkin squash cucumber salad, ACS=Avocad cucumber salad.

Table 2: Vitamins and minerals composition of the diets from developed recipes

Diet	Nutrient Composition			
	Vitamin C (mg/100g)	Vitamin E (mg/100g)	Calcium (mg/100g)	Chromium (mg/100g)
SPV	34.38±0.08	2.08±0.00	0.03±0.01	0.02±0.00
FTS	36.66±0.08	5.33±0.00	0.00±0.00	0.00±0.00
VPD	19.32±0.48	2.30±0.01	0.01±0.00	0.02±0.01
SWC	19.32±0.48	2.30±0.01	0.01±0.00	0.02±0.01
PWF	68.15±0.16	0.44±0.01	2.39±0.05	0.00±0.00
CGP	8.88±0.16	0.71±0.02	0.00±0.00	0.00±0.00
PFS	33.16±0.32	0.08±0.01	0.09±0.01	0.02±0.00
SGF	38.11±0.16	1.30±0.01	0.05±0.01	0.00±0.00
PSC	7.52±0.08	0.43±0.00	0.03±0.00	0.00±0.00
ACS	31.58±0.08	0.32±0.02	0.33±0.02	0.00±0.00

Mean ± Standard deviation of three determinations; Mean values in the same rows are significantly different ($P<0.05$)

Key to Table 2:

SPV=Sweet potatoe vegetable pudding, FTS=Fried tapioca salad, VPD =Vigna pottage delicacy, SWC=Steamed whole cowpea, PWF=Pleurotus wheatmix flakes, CGP=Corn garden egg pudding, PFS=Papaya fruit salad, SGF=Star ginger fruitveg drink, PSC=Pumpkin squash cucumber salad, ACS Avocado cucumber salad.

Table 3: Sensory properties of the diets from developed recipes (n = 12)

Diet	Colour	Aroma	Taste	Texture	Overall acceptability
SPV	8.00±1.07	8.13±0.99	7.50±1.69	7.75±1.28	7.75±1.16
FTS	7.75±1.16	5.50±2.56	6.13±3.00	7.38±1.60	5.88±2.80
VPD	7.25±1.28	6.75±2.12	5.88±2.59	5.75±2.55	6.63±1.85
SWC	8.75±0.46	8.38±1.06	8.25±0.89	8.50±0.76	8.38±0.92
PWF	5.75±1.28	7.00±1.20	5.88±1.73	6.25±1.83	6.25±2.05
CGP	7.25±0.89	7.25±1.28	6.75±2.19	7.50±1.07	7.50±1.77
PFS	8.63±0.74	8.50±1.07	8.13±1.36	8.00±1.20	8.34±1.06
SGF	7.13±2.30	6.25±2.12	5.00±2.40	6.63±2.20	5.88±2.36
PSC	8.13±0.83	6.00±2.39	5.13±2.70	7.75±1.04	6.40±2.26
ACS	8.50±0.76	7.38±1.19	8.00±1.41	7.50±1.07	8.00±0.76

Mean values in the same rows are significantly different ($P<0.05$)

Key to Table 3:

SPV=Sweet potatoe vegetable pudding, FTS=Fried tapioca salad, VPD =Vigna pottage delicacy, SWC=Steamed whole cowpea, PWF=Pleurotus wheatmix flakes, CGP=Corn garden egg pudding PFS=Papaya fruit salad, SGF=Star ginger fruitveg drink, PSC=Pumpkin squash cucumber salad, ACS=Avocado cucumber salad.

The texture of the diets ranged from 5.75±2.55 to 8.5±0.76. SWC(8.5±0.76) had the highest value and is significantly (P<0.05) different from other diets. The overall acceptability of SWC(8.38±0.92) was significantly (P<0.05) higher than other diets.

DISCUSSION

The diets SWC(217g per serving), PWF(217g per serving) and ACS(432g per serving) can be used for the management of diabetes because they have appreciable amount of protein, fiber, vitamin C, chromium and low contents of fat and carbohydrate. The protein content of SWC is appreciably high (1.80g/100g) compared to other diets. High protein diet have been reported to produce a relative improvement in plasma insulin responses for the blood glucose levels [28]. It was concluded that a high protein diet is a beneficial therapy for mild diabetic patients. The carbohydrate content is low (15.92g/100g), this makes it a healthy meal for diabetics. The Chromium content of SWC is appreciable, it is 0.02mg/100g. The effects of chromium supplementation on body weight and composition in individuals with and without diabetes has been documented [29]. The fiber content of the PWF diet is high (1.68g/100g) compared to other diets. The high crude fiber content of PWF could be due to the high fiber content of mushroom. Diets rich in dietary fiber decrease the re-absorption of bile acids, thus reducing circulating cholesterol levels and increasing glucose tolerance[30]. Dietary fiber also plays a significant role in the prevention of several diseases such as: cardiovascular diseases, diverticulosis, constipation, irritable colon, cancer, and diabetes[31]. The vitamin C content of PWF is very high (68.15mg/100g) compared to other diets. Though diabetes is not traditionally considered a risk factor for vitamin C deficiency, patients with diabetes should all receive dietary advice about healthy eating and vitamin C dietary sources, including fresh fruits and vegetables[32]. Vitamin C prevents oxidative stress and is known to interact with glucose transporters, potential mechanisms by which it may also alter glucose homeostasis[33]. Vitamin C leads to an improvement in hyperglycemia[34]. The ACS diet has the least energy value (20.45 kcal/100g) compared to other diets. The fat content is low (1.05g/100g). Avocado pear has healthy fat(monounsaturated) which is one of the ingredients used in preparing this diet.

The diets VPD(360g per serving) and SGF(297g per serving) can be used for the management of arthritis. The VPD has the highest calcium content (2.66mg/100g) compared to other diets. Calcium plays a role in healthy bones and also supports the nervous system. VPD also had the highest content of vitamin E (7.80mg/100g) compared to other diets. Vitamin E has been reported to possess anti-inflammatory[35], anti-oxidative[36] and anti-hypercholesterolemic[37] properties through regulation of various signaling pathways. The star ginger fruitveg drink(SGF) ranked second in vitamin C content(38.11mg/100g) and so can be used to manage inflammations in arthritis. Vitamin C reduces inflammatory response. Vitamin C is a powerful antioxidant that fights molecules that trigger joint inflammation[38]. It is a co-factor in collagen synthesis, the main protein in joint tissue and bone. It also plays a role in fighting infection and may work to control inflammation linked to infection, which may trigger arthritis flares. The diets SPV(243g per serving), PWF and PFS(366g per serving) can be used for improvement of nutritional status. The SPV has appreciable energy, carbohydrate, protein, fat and crude fiber, the vitamin C content of PWF, SPV and PFS are high. PWF has the highest content of vitamin C. The high content of Vitamin C could be attributed to the ingredients date palm fruit and *Pleurotus tuber regium* mushroom present in the diet. This is similar to an earlier report were the highest quantity of vitamin C was obtained for *Pleurotus ostreatus* mushroom(68.06 mg/100g)[39]. Also mushrooms have health promoting properties such as antioxidant. Date palm fruit have been reported to contain flavonoids, sterols, procyanidins, carotenoids, anthocyanins, sugar (glucose, sucrose and fructose) with low glycemic index, dietary fibers, less protein and fats, vitamins such as riboflavin, biotin, thiamine, ascorbic and folic acid, and mineral[40]. Date palm fruits may be classified as low glycaemic index food items, hence its consumption may be of benefit in glycaemic control in non-diabetics[17]. Papaya fruit salad(PFS) has appreciable amount of nutrients. This diet is prepared with fruits which are known to be rich in antioxidants, phytochemicals, vitamins and minerals which are beneficial to health.

Organoleptic study analysis indicated that among ten diets prepared, SWC has got highest

acceptance by all sensory parameters except for its aroma. PFS diet ranked second by all sensory parameters and first for its aroma.

CONCLUSION

The study concluded that nutrient composition of the diets from developed recipes can be used to manage diabetes and arthritis and for improvement of general nutritional status of an individual. The therapeutic diets from developed recipes have appreciable amounts of nutrients especially vitamin C. Therefore, the use of well combined indigenous foods can be used for the management of diseases and is recommended for diabetic and arthritis individuals and also can be used to improve general nutritional status.

RECOMMENDATIONS

From this study, It can be recommended that Nutritionists and Dietitians advocate for the use of indigenous foods as a therapeutic measure for management of diseases. Locally available fruits and vegetables should be incorporated into daily intake to ensure good nutrition and wellbeing. These diets from developed local recipes could be used to manage diabetic, arthritic and healthy individuals to boost their immune system and prevent metabolic diseases.

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