



SENSORY EVALUATION OF DEVELOPED FOOD PRODUCTS FOR HEMODIALYSIS PATIENTS

¹Bhavana Shailendranath, ¹Ushadevi, C. & ²Prashant G. Kedlaya

Department of Food and Nutrition, Smt. VHD Central Institute of Home Science, Seshadri Road, Gandhi Nagar, Bangalore, Karnataka 560 001, India

²Department of Nephrology, St. John's Medical College Hospital, Sarjapur Road, Bangalore, Karnataka 560 034, India
Corresponding Author's email: reach2bhavana@yahoo.co.uk

ABSTRACT

Patients with renal failure, chronic kidney disease (CKD) on hemodialysis form a challenging group for nutrition specialists to meet their nutritional requirements and also nutritional, fluid restrictions. Characteristics peculiar to chronic kidney patients like dry mouth, inflamed oral mucosa due to affect of salivary ammonia, decreased appetite due to uremia and also impaired gastric motility add to the problem of their decreased food intake and dislike for food items. There is always a discrepancy between dietary advice given and its acceptance, adherence by CKD patients. To overcome this hurdle, we embarked on a unique venture of developing renal recipes in accordance with dietary requirements and restrictions. We developed five renal recipes and subjected these products for sensory evaluation both by CKD hemodialysis patient group and a control group of normal population. We found that all five developed recipes had high acceptability by patient group. We suggest that apart from nutritional advice, developing new recipes and subjecting them to sensory evaluation should become a routine tool to overcome dietary monotony and improve nutritional adherence by these CKD patients.

KEYWORDS: hemodialysis, renal recipe, sensory quality.

INTRODUCTION

Sensory evaluation has been defined as a scientific discipline used to evoke, measure, analyze and interpret those responses to products that are perceived by the senses of sight, smell, touch, taste and hearing (Joel and Herbert, 1993). Sensory evaluation consists of judging the quality of food by a panel of judges. Every time food is eaten a judgment is made. Quality is the ultimate criterion of the desirability of any food product. When the quality of a food product is assessed by means of human sensory organs, the evaluation is said to be sensory or subjective or organoleptic or psychological evaluation. Sensory quality is a combination of different senses of perception coming into play in choosing and eating a food. Appearance, flavor and mouth feel decide the acceptance of the food. The sensory characteristics of food are appearance, color, flavor, texture (Srilakshmi, 2010). The overall quality of a food depends on the nutritional and other hidden attributes, and sensory quality as assessed by means of human sensory organs. The evaluation deals with measuring, analyzing and interpreting the qualities of food as they are perceived by the senses of sight, taste, touch and hearing (Shakuntala, 2013). The sense of taste is important for consumption and enjoyment of food (Kim *et al.*, 2004). Taste influences food palatability and appetite. Patients with renal failure have decreased taste sensitivity. Dialysis patients have commonly poor appetite do not enjoy eating and complain of food particularly protein as being disagreeable (Elisabeth *et al.*, 1978). The taste disturbances in end stage Renal Disease (ESRD) patients could be caused by metabolic disturbances, use of medications, a diminished number of taste buds and

changes in salivary flow rate and composition. Sour and sweet tastes can be more seriously affected than bitter and salty tastes (Burge *et al.*, 1984). ESRD patients undergoing hemodialysis (HD) show apparent oral and salivary changes. The accumulation of ammonia might irritate the oral mucosa, resulting in mucosal inflammation. A decrease in salivary mucin coating over the oral mucosa makes it vulnerable to infection, inflammation and tissue damage leading to tongue and mucosal pain (Kaushik *et al.*, 2013). Taste active compounds present in the salivary fluid particularly bicarbonate and urea are associated with altered taste perception and might influence food consumption mainly protein rich foods (Manley *et al.*, 2012). Dry mouth is observed in renal patients due to restricted fluid intake, drug side effects, salivary gland alteration and oral breathing secondary to lung perfusion problems (Estela *et al.*, 2005). Saliva affects taste sensitivity in various ways such as through diffusion of taste substances, chemical interaction with taste substances, and also stimulation of taste receptors and protection of taste receptors. The concentration of the salivary constituents of different individuals and in the same individual, under different circumstances varies greatly. Taste sensitivity may also fluctuate widely. Taste perception of the five qualities is highly variable between individuals with genetic, physiological, nutritional, environmental and socio-cultural factors all playing a role within the individual (Matsuo R., 2000). Patients on HD have significant acute effects on both salivary secretion rate and protein concentrations in saliva and the changes are mainly due to an increased watery secretion from the salivary glands

(Bots *et al.*, 2007). The socio-economic impact of Chronic Kidney Disease (CKD) and its complication are to be considered (Stevens *et al.*, 2007). There is a close association among appetite, malnutrition, inflammation and outcome in patients undergoing prevalent HD. Their study shows uremic men being more susceptible to inflammation induced anorexia than uremic women (Juan, *et al.*, 2007). Decreased energy availability in CKD patients appears to be responsible for a reduced protein synthesis rates. HD is a catabolic procedure as the patient's on dialysis days are in negative nitrogen balance, even with high levels of protein intake. Malnutrition is often a major issue in HD patients was not only poor nutrient intake is the causative factor but other complex factors are nutritional and metabolic derangements in uremic patients. A prolonged decrease in muscle activity is associated with muscle weakness, muscle atrophy, and negative nitrogen balance leading to loss of lean body mass (Sungjin *et al.*, 2012). Nitrogen balance is negative on dialysis days regardless of protein intake and that urea nitrogen generation is higher on dialysis days. The negative nitrogen balance could result from amino acid loss in dialysate and from increased catabolism stimulated by loss of glucose into dialysate (Michael *et al.*, 1978). Nearly 10%-30% of HD patients have poor appetite and this narrows the range of food consumed with renal diet restriction on many foods. Diet monotony strongly correlates with nutritional intake (Jennifer *et al.*, 2003). They are overwhelmed with what they should not eat leading to poor intake caused due to lack of variety and non adherence to renal dietary regimen (Kathryn, 2000). Nearly 40% of patients' undergoing HD suffers from varying degrees of Protein Energy Malnutrition (PEM) (Mehrotra and Kopple, 2001). The main cause of malnutrition are inadequate food intake secondary to anorexia caused by the uremic state altered taste sensation, intercurrent illness, emotional distress or illness impaired ability to procure, prepare or mechanically ingest foods, unpalatable prescribed diets (2005, guidelines). Hemodialysis patients have high rates of psychological distress and nonadherence to diet prescription and depressive symptoms are highly associated with dietary nonadherence (Khalil and Frazier, 2010). Earlier studies shows that patients who have achieved adequate dialysis have a better appetite and better protein intake than those with poorly dialysed (Kamat *et al.*, 2000). There is a complex interplay in CKD dialysis patients between various factors like food quality, sensory perception by patients, patients' physical condition, nutritional requirements and advice given and actual patient acceptance of food product, adherence to nutritional advice. The present study was conducted to determine the sensory evaluation of Indian homemade renal recipes developed (protein rich, fluid restricted, low in minerals) so as to ascertain the degree of acceptance.

Operational Definitions

Sensory evaluation: the quality of food product is assessed by means of human sensory organs, Appearance: an impression of the visibility of a substance, Color: the property possessed by an object of producing different sensations on the eye as a result of the way the object reflects or emits light, Flavor: the general/distinctive

quality of taste in a food *i.e.*, mingled sensation of smell and taste, Texture: the feel, appearance, or consistency of a surface or a substance & Taste: the sensation of flavor perceived in the mouth and throat on contact with a substance.

MATERIALS & METHODS

Study consisted of two group's *viz.* patient and control group. Selection of respondents, CKD stage V patients on regular maintenance hemodialysis regimen of either gender with 18 years of age formed the study population of patient group and other group hemodialysis patient care givers (normal subjects) of either gender with age 18 years of age formed the study population of control group. Study groups who gave voluntary consent to participate in the study. Exclusion Criteria are patients with established liver disease and those with retro viral positive, malignancy, active infections, grossly fluid overloaded patients.

Study Design

Patient undergoing regular hemodialysis sessions (8-12 hours per week) at St. John's Medical College Hospital, a 1200 bedded tertiary care centre were selected for the study. A cohort, interventional study was conducted on 30 samples from patient group and 30 samples from control group for each food product developed. Institutional Ethics Committee approval was attained for the conduct of the study. Renal food products of five different varieties were developed and each product was individually assessed for sensory evaluation. The five developed food products were subjected to sensory evaluation. Each product was subjected to sensory evaluation on different days to both the groups to prevent taste interference. A five-point hedonic rating scale was used. A hedonic rating test was used to measure the degree of pleasurable and unpleasurable experience of the food product. A five point hedonic rating scale comprised scoring from 5—1, illustrating 5-Like very much, 4-Like Moderately, 3-Neither Like nor Dislike, 2-Dislike Moderately, 1-Dislike very much. Greater the score is the greater degree of acceptability of the food product. The hedonic rating scale questionnaire was validated by subject experts.

Patients' appetite status, medication interference, psychological distress, anaemia, uremic symptoms were evaluated and screened before sensory evaluation assessment. The quality of food product was assessed from each group in a relaxed atmosphere. The food products developed were homemade recipes complementing on renal dietary requirement—high protein, low electrolytes and solid (fluid restricted) form. The panelists were trained and instructed not to have full meals to satiety before evaluation. Basic sensory evaluation technique was followed to assess the products. The 5 products developed were as follows;

- Product 1: Shrikhand
- Product 2: Methi Parata
- Product 3: Dhokla
- Product 4: Corn Pulao
- Product 5: Chicken Gravy

Appendix I: Basic materials required for each product

Shrikhand: Thick curds, strained, mixed with sugar (optional) and churned to a sweet dish.

Methi Paratha: Leached methi leaves, wheat flour, spices, roasted like a roti with low fat.

Dhokla: Green gram, curds, spices and steamed.

Corn Pulao: Rice, corn, green gram, spices, cooked with

low fat.

Chicken gravy: Chicken pieces, onion, spices, cooked like gravy.

Appendix II: Nutritional value of products

Food Product	Portion size (gm.)	Nutrient content							Cost (Rs.)
		Energy (Kcal.)	Protein (gm.)	Iron (mg.)	Calcium (mg.)	Phosphorus (mg.)	Sodium (mg.)	Potassium (mg.) (Unleached)	
Shrikhand	50	144	7.81	0.005	90.31	60.12	1.40	2.69	17.00
Methi Paratha	50	143	4.5	2.38	85.23	120.94	310.28	106.95	7.00
Dhokla	50	96	4.49	1.35	22.61	78.25	31.91	202.08	6.00
Corn Pulao	50	77	2.1	0.85	13.50	50.62	165.45	66.52	10.00
Chicken Gravy	50	89	8.19	0.98	16.56	85.54	153.62	11.89	12.00

Statistical Analysis: One-Way Analysis of Variance of each sensory characteristic was adapted to analyze the rating. MINI tab 7.0 package was used for analysis.

RESULTS

Demographic characteristics are presented in Table-1.

74% of the patient group belonged to the age group between 41-60 years on par with 63% among the control group. Majority of the respondents among the patient group were male gender (67%) while female gender (57%) comprised from the control group.

TABLE 1: Demographic Profile of Respondents

Characteristics	Category	Respondents (Patient group, n=150)		Respondents (Control group, n=150)	
		Number	Percent	Number	Percent
Age group (years)	40	3	10.0	7	23.0
	41 – 50	11	37.0	12	40.0
	51 – 60	11	37.0	7	23.0
	>60	5	16.0	4	14.0
Gender	Male	20	67.0	13	43.0
	Female	10	33.0	17	57.0

Response rating scores was found higher with respect to Appearance (4.70) and Color (4.70) among patient group as compared to Flavor (4.80) and Texture (4.80) for Food Product 1, Shrikhand. However, the difference in the mean

response between patient group and control group was found to be non-significant for all the characteristics under study (p value >0.05) as shown in Table-2.

TABLE 2: Sensory characteristics response scores of Product 1 (Shrikhand)

Characteristics	Response (n= 30)		F Value
	Patient group	Control group	
Appearance	4.70	4.73	0.08, NS
Color	4.70	4.77	0.33, NS
Flavor	4.60	4.80	2.90, NS
Texture	4.63	4.80	2.05, NS
Taste	4.60	4.73	1.18, NS

NS: Non-significant,

Max. Score = 5

Table-3 shows Appearance (4.57) being higher response scoring followed by Color (4.50) among Patient group while Appearance (4.63), Color (4.63) and Flavor (4.63) being higher among Control group. The difference in the

mean response between Patient group and Control group was evident as non-significant for all the characteristics of food product 2, Methi Paratha (p value >0.05)

TABLE 3: Sensory characteristics response scores of Product 2, Methi Paratha

Characteristics	Response (n=30)		F Value
	Patient group	Control group	
Appearance	4.57	4.63	0.24, NS
Color	4.50	4.63	0.94, NS
Flavor	4.43	4.63	2.13, NS
Texture	4.47	4.57	0.42, NS
Taste	4.37	4.57	1.56, NS

NS: Non-significant, Max. Score = 5

Regarding the response rating scores for Product 3, Dhokla, and Color (4.70) was found to be higher and next in line was Appearance (4.67) and Texture (4.67) among Patient group as compared to Flavor (4.83) and

Appearance (4.80) among Control group. The difference in the mean response between both the groups as in Table-4, was found to be non-significant for all the characteristics studied (p value >0.05).

TABLE 4: Sensory characteristics response scores of Product 3, Dhokla

Characteristics	Response (n=30)		F Value
	Patient group	Control group	
Appearance	4.67	4.80	1.15, NS
Color	4.70	4.73	0.06, NS
Flavor	4.63	4.83	1.82, NS
Texture	4.67	4.70	0.05, NS
Taste	4.60	4.70	0.40, NS

NS: Non-significant, Max. Score = 5

Table-5 shows response rating score being higher in Color (4.90) among patient group while Appearance (4.90), Flavor (4.90) and Taste (4.90) among control group for product 4, corn pulao prepared. However, the difference in

the mean response for all the characteristics under study between patient group and control group was found to be non-significant (p value >0.05)

TABLE 5: Sensory characteristics response scores of product 4, Corn Pulao

Characteristics	Response (n=30)		F Value
	Patient group	Control group	
Appearance	4.87	4.90	0.16, NS
Color	4.90	4.87	0.16, NS
Flavor	4.80	4.90	0.92, NS
Texture	4.77	4.80	0.08, NS
Taste	4.60	4.90	3.58, NS

NS: Non-significant, Max. Score = 5

Response rating score was found to be higher with respect to Appearance (4.93) and next was Color (4.90) and Flavor (4.90) among patient group as compared to Appearance (4.97), Color (4.97), Flavor (4.97) and Texture (4.97) among control group from the food product

5, Chicken Gravy prepared. The difference in the mean response between the groups was found to be insignificant for all the characteristics under study (p value >0.05) as seen in Table-6.

TABLE 6: Sensory characteristics response scores of Product 5, Chicken Gravy

Characteristics	Response (n=30)		F Value
	Patient group	Control group	
Appearance	4.93	4.97	0.34, NS
Color	4.90	4.97	1.05, NS
Flavor	4.90	4.97	1.05, NS
Texture	4.87	4.97	1.96, NS
Taste	4.83	4.90	0.56, NS

NS: Non-significant, Max. Score = 5

As depicted in Figure-1, the mean response scores of overall acceptability of all the five food products prepared shows nearly equal acceptability among patients as well as controls. Between the two groups Product 5-chicken

gravy was rated first following the order next in series as Product 4-Corn Pulao, Product 1-Shrikhand, Product 3 Dhokla and Product 2-Methi Paratha indicating renal food product developed are palatable.

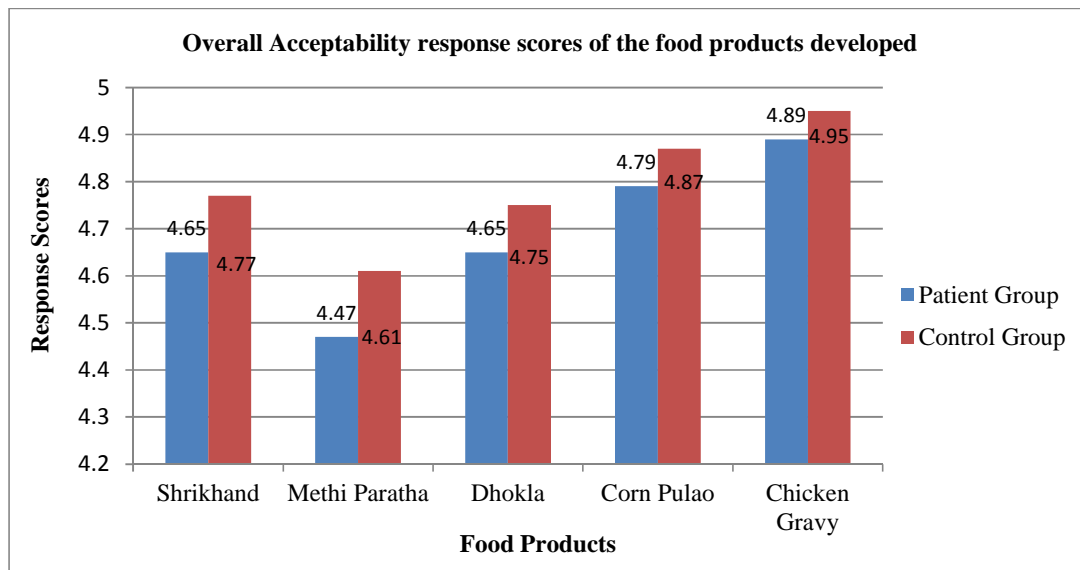


FIGURE 1: Overall acceptability of all the food products developed (Mean response scores)

DISCUSSION

Role of health care givers in renal population is immense and supporting to the health status. Nutrition intervention becomes an important component in optimizing diet among renal patients. With consistent monitoring and improving the nutritional status of renal patients food disciplinary becomes an essential part to achieve the goal. Demonstration and use of renal recipes may be helpful in educating the patients and care takers to emphasize on renal dietary regimen. Food is a universal medium for expressing sociability and hospitality. It is righteous to term “food for thought”. Culture, beliefs, religion, ethnicity play a major role in eating patterns and diet of all people. Almost every culture has a staple grain around which its cuisine is centered. A study was conducted in South Africa by Conradie, N. and group on development and sensory evaluation of 30 recipes suitable for chronic renal failure patients. 45 dialysis patients participated in this study and 23 recipes that received a score of 6 (Like Slightly) or more for all the characteristics, the overall score by 80% were deemed acceptable and were included in the Renal Smart web-based program (Conradie *et al.*, 2009). Jennifer and team found from their study that diet monotony strongly correlates with nutritional intake. Though patients’ with monotonous diets have a good appetite for several high-protein food that they are not eating; assisting patients’ to identify and increase the intake of these foods may both enhance diet variety and improve nutritional status (Jennifer *et al.*, 2003). An intensive effort for dietary education may aim at increasing the protein intake in HD patients. The morbidity and mortality of dialysis patients is high and appropriate dietary intervention might help to improve nutritional status and hence quality of life (Kamat, 2000). Insufficient social support, decreased behavioral compliance with the dialysis prescription, and increased negative perception of the effects of illness are independently associated with increased mortality in ESRD patients treated with HD (Paul *et al.*, 1998). Taste improves immediately after a dialysis session although not

to normal levels (Jean *et al.*, 1979).

Indian cuisine has its own popularity and demand in today’s world. Food is a source of power to our patients. Based on the nutritive value and availability of Indian food products, recipes were chosen and developed that would meet the specified criteria to suit our renal population and user friendly. An attempt was made to include tasty recipes that the patients’ would find attractive, inexpensive, quick and easy to incorporate into their daily life. Natural blend of Indian spices and condiments were inclined to prepare the therapeutic foods. Every effort was made to achieve the renal dietary regimen as a wholesome homemade foods *viz.* high/adequate caloric, high/optimum protein, low sodium, low potassium and less fluid (solid form) along with procuring the delicacy. Ingredients used for product production were readily available and are basic at all Indian home kitchen. It is universally accepted that the nutritive value of food is not primarily what makes people eat. It is its colour, flavour, texture, temperature and presentation. *Sensory Evaluation* is advocated as a methodology to develop new recipes for renal patients. Only nutritional advice may not suffice. Newer intervention like this might help for better acceptability and adherence which would improve overall nutritional status.

Each product chosen has its significance.

Shrikhand: a dessert which transforms ordinary curds into a delicacy (solid form).

Methi Paratha: Paratha stuffed with the goodness of methi (fenugreek leaves), mildly spiced. Fenugreek leaves or methi leaves are very good for health as they are rich in antioxidant, iron and also a good source of dietary fiber. Leached and sautéed methi leaves with spices kneaded along with whole wheat flour and rolled out like a roti improves color, flavor and texture reducing the moisture content of food, improving the keeping quality.

Dhokla: a quick and appetizing snack. This dish was incorporated from besan to moong dhal. This preparation requires soaking moong dhal in advance and blenderised

with mild spices and steamed where texture is light, fluffy, enhances the flavor and digestibility.

Corn Pulao: a rice dish made of corn kernels, moong dhal, rice tossed and sautéed with spices. When cooked together the product is slightly moist, tender without any liquid or

gravy and adds to the nutritional value.

Chicken Gravy: This is a type of chicken curry in thick gravy with a nice spicy flavor. Cooking the meat softens the connective tissue and improves digestibility, texture and hence it becomes more chewable and easily digestible.



Shrikhand
(Product 1)

Methi Paratha
(Product 2)

Dhokla
(Product 3)

Corn Pulao
(Product 4)

Chicken Gravy
(Product 5)

Part of the non-acceptability and non-adherence to dietary regimen prescribed is due to dietary monotony and lack of knowledge by patient and patient care givers to prepare good and tasty renal recipes with easily available low cost ingredients, with high nutritional value, still complying with the nutrient/fluid restriction required. It is a challenge to balance nutritional requirement (high calorie, high protein) and also nutritional restriction (low potassium, low sodium, less fluid) while preparing renal recipe. Along with this altered taste pattern of renal patients adds to the challenge of preparing recipes. Ours is a unique venture in which we have developed renal recipes with high nutritional value and subsequently subjected these recipes for sensory evaluation by both patient group and normal group (controls). We noted that there is a good acceptability of all the five products as evidenced by the response scoring in both the groups. It is possible to develop renal recipes with good acceptability.

CONCLUSION

“Acceptance” of developed renal recipes among patient group was similar to the control group. This indicates that all the five renal recipes which were developed are palatable and acceptable even to CKD-dialysis patients. Patient’s group had high acceptability scores for chicken gravy followed by corn pulao. As all the “five food products” were prepared keeping in accordance the restrictions of renal hemodialysis patients and also as they have high nutritional value, these products could be advocated for hemodialysis patients to benefit them of not only high nutritive value but also some happiness of tasty food. Sensory evaluation is a useful, essential tool for developing new renal recipes acceptable to patients with kidney disease.

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