DEVELOPMENT OF A NATURAL CURRY CUBE USING PUMPKIN SEED POWDER

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INTRODUCTION

Today there is a growing awareness among consumers regarding the food ingredients that cause adverse health effects. The use of preservatives, flavor enhancers, and colors in processed food products has become a common practice to enhance consumer attraction and shelf life. Artificial flavors and flavor enhancers are the largest class of additives added to enhance the taste of the food. Most of the seasoning cubes contain Monosodium Glutamate (MSG) chemical to increase the flavor in ready to cook or ready to eat food. The soup cubes used in Nigeria are taste enhancers and reported that the major active ingredient in the soup cubes is MSG. (Akapanyung, 2005). Many research findings showed adverse health effects such as causing cancer, health issues in pregnant women, and new borne due to excessive consumption of monosodium glutamate as a food ingredient (Siddiqua et al, 2009). Synthetically derived flavor enhancers such as benzophenone, ethyl acrylic, myrcene, pulegone, pyridine, and methyl eugenol were removed from the food additive regulations under the Delaney Clause of the Federal Food, Drug, and Cosmetic Act in the U.S.A. (Food and Drug Administration, 2018). Therefore, there is a need to find natural flavor enhancing food ingredients. Roasted Pumpkin seed powder was used as a flavor in ancient tribes in Sri Lanka in their food tradition (Gunasekara, 2018).

Pumpkin belongs to the genus *Cucurbita* and the family *Cucurbitaceae.* Pumpkins are grown in rural areas in dry and intermediate zones of Sri Lanka. The total cultivation of pumpkin is 217,222 Tons (Ministry Of Agriculture, 2017). Generally, pumpkin wastage is contributing to nearly 30-40-% (DOA, 2010), and no proper market for wasted pumpkin seeds. In recent years, seeds and nuts have received more and more attention due to the high nutritional and therapeutic value of their biologically active ingredients (Shandilya, & Sharma, 2017; Chari, *et al.*, 2018; Rezig *et al.*, 2019; Yang *et al.*, 2019). According to Patel (2013), pumpkin seeds are uniquely flavored with a nutty taste and are consumed as roasted, salted snacks. Furthermore, pumpkin has received considerable attention in recent years due to its nutritional and health protective values of the seeds. Pumpkin seeds are rich in functional ingredients. They are vitamin E (tocopherol), carotenoids, provitamins (Brozni'c., *et al.*, 2016), pigments, pyrazines, squalene, saponins (Naziri *et al*., 2016), phytosterols, triterpenes, phenolic compounds and their derivatives (Abou-Zeid et al., 2018; Acorda et al., 2019), coumarin, unsaturated fatty acid, flavonoids and proteins (Dakeng et al., 2012). In addition, pumpkin seeds are an excellent source of magnesium, potassium, phosphorus and other trace minerals such as zinc, manganese, iron, calcium, sodium and copper. The seeds of pumpkin representing 3.1% of total pumpkin fruit weight are rich in protein (33%), high in sulfur containing amino acids and low in phytic acids and with trypsin inhibitor (Samaha, 2002). Pumpkin seeds are also known for pharmacological activities like anti-fungal, anti-diabetic, anti-bacterial and anti-inflammation activities (Kaur and Sharma, 2017) Pumpkin seeds have many health benefits to lower cholesterol and reduce the risk of bladder stone disease (Suphakarn, 1987). Studies have revealed that pumpkin seeds may reduce hormonal damage to prostate cells and reduce the risk level of prostate cancer. (Dhiman et al, 2009). The main objective of the present study was to develop a natural curry cube using pumpkin seed powder.

2. METHODOLOGY

The experiment was carried out at the Food Processing Laboratory, University Vocational Technology, Rathmalana, Sri Lanka. Pre inspection was done to select quality raw materials by considering discoloration and pest damages.

Preparation of raw materials

Well-ripen pumpkins were bought from the local market and pumpkin seeds were collected. Then pumpkin seeds were washed well. Then seeds were subjected to dehydration at 62°C for 48 hours using laboratory scale dehydrator (PS800, Spain). The dehydrated pumpkin seeds were powdered using a grinder and sieved through a 300 µm sieve and stored in airtight container until further use**.** Similarly, coriander seeds and cumin seeds were collected and rinsed well to remove dirt, dehydrated, ground, and packed in polythene (LDPE 250 gauge) until further use.

Preparation of formulas

Three formulations were developed by mixing pumpkin seed powder (55%, 60%, and 70%), Soya oil (35%, 30%, and 20%) and equal quantities of other ingredients as shown in Table 1. Twelve grams of each homogenized mixture was formed into a cube form.

Table 1: Design formulas with composition

	Treatment and its percentage		
Ingredient	**T1**	**T2**	**T3**
Pumpkin seed powder	55	60	70
Soya Oil	35	30	20
Coriander	5	5	5
Cumin	5	5	5

Finally, they were stored at room temperature. The best samples were selected using sensory evaluation.

Sensory Evaluation

The untrained panel of 30 members was selected from the University of Vocational technology representing different age groups and both sex for the sensory panelists. The samples were evaluated for attributes of color, appearance, flavor, taste, texture, odor, overall acceptability. Bean curry was made using 200 g of beans, 90 ml of thick coconut milk and pinch of turmeric, salt and curry leaves, with 12 g of pumpkin cube. Three bean curries were prepared for each treatments.

Chemical and physical analysis of developed curry cube

Crude protein, crude fat, crude fiber, ash, moisture, and pH value of the selected cube were analyzed using standard AOAC (1995) and AOAC (2012) methods. All of the analyses were carried out in triplicate. Final results were taken by mean values. The total carbohydrate calculated as 100 %- (% Protein + % Fat + % Moisture + % Ash + % Fiber). (Al Subhi, 2013)

Microbial analysis of developed curry cube

Total plate count, Coliform, Yeast, and Moulds were analyzed using SLSI standards using plate count Agar (PCA), Eosin methylene blue agar (EMB), and Malt Yeast Peptone Glucose Agar (MYPG) respectively**.** Ten grams of Pumpkin cube was diluted in 90 ml of saline and prepared serial dilutions. Dilutions were mixed with PCA agar and allowed solidifying. Solidified dishes were inverted and incubated 37±1°C for 72 hours. Plates with 15-300 colonies were chosen and counted. (Sri Lanka Standard 516: part 2/Section 1:2013 ISO 4833-

12013) for total plate count. EMB plates were incubated at 36°C±1°C for 24 hrs and examined for typical *Escharichia .coli* colonies. Typical colonies are pink to red colonies showing greenish metallic sheen. (Sri Lanka Standard 516: part 3:1982) To the determination of yeast and mould, 100 µl the inoculum was spread on the agar surface with a sterile bent rod. The plates were allowed to dry at room temperature. It was incubated at 25°C ± 1°C for five days. The plates were read after incubation. The dishes containing less than 150 colonies were selected (Sri Lanka Standard 516: part 2/section 1:2008).

Statistical analysis

Sensory evaluation results were analyzed using Minitab 14 software package with Fried man test. Physical and chemical analysis results were expressed as mean ± SD.

RESULTS AND DISCUSSION

Sensory evaluation

The results obtained from the sensory evaluation of the three treatments are presented in Table 2. T3 containing pumpkin seed powder 70% and 20% soya oil with other ingredients showed significantly highest ($P<0.05$) values for all the tested sensory parameters. Further, T3 showed the highest median scores for all the tested parameters.

Table 2: Sensory evaluation attributes for treatments

Attribute	Treatment 1		Treatment 2		Treatment 3	
	Medien	Average	Medien	Average	Medien	Average
Color	2.9	65.5^{a}	3.1	75.5^{a}	4	100.5^{b}
Appreance	3.2	81.5^{ab}	2.9	62.5^{a}	3.8	100^{c}
Flavor	3	68^{a}	3.1	71.5^{a}	3.8	96.5^{b}
Taste	3	72.5^{a}	3	62^{a}	4	102^{b}
Texture	3	69.5^{a}	3.2	67^{a}	4	105^{b}
Odor	3	64.5^{a}	3	69.5^{a}	4	103.5^{b}
Overall Acceptability	3	65.5^{a}	3.4	79.5^{ab}	4.4	104^{c}

*Rank score in the same column with different superscript are significantly different at $P<0.05$

Physical and chemical analysis of selected curry cube

Table 3 is shown the physical and chemical analysis results. The higher amount of crude fat 30.6% and crude protein 23.5% were found in the developed flavor enhancer cube.

Table 3: Physical and chemical analysis of selected flavor enhancer cube

Treatment	Treatment 3 (Pumpkin seed powder70%: Soya oil 20%)
Crude Protein	23.5± 1.4*
Moisture	9±0.5
Crude Fat	30.6±2.9
Total Ash	16.7±5
Crude Fiber	14.7±2.8
pH	5.6±0.06
Carbohydrate [a]	14.5±0.

*Values are means of three replicates ± Standard deviation; Percentage of carbohydrate was calculated by difference (100% - moisture %+ fat %+ protein %+fiber %+ ash %)

Surprisingly, the developed natural curry cube contained 23.5 % protein content. Protein content compared to mushroom cube, locally available Maggi vegetable cube, Maggi chicken cube, and Maggi beef cube with 7.9%, 4.8%, 8.6%, 6.9% much lower protein content respectively (Al Subhi, 2013). According to Robinson et al, (1981) reported that pumpkin seeds are the rich protein source (38%) and this may be contributed to a high content of protein in the final product. The moisture content determined in the developed natural curry cube was 9%. When the moisture content of dried materials contained less than 10%, such materials enhance the keeping quality of soup ingredients (EI Wakeel, 2007).The moisture percentage of the sample highly affects the shelf life of the product (Gilbor et al, 2019). This may be due to the usage of well dehydrated pumpkin seeds and sun dried spices in the formulation. Crude fat content in developed curry cube 30.6% was found to be fairly higher than the crude fat content of the developed mushroom broth cube which contained (3.8%) by Al Subhi, (2013). Buck, (1981) reported soya oil contains approximately 85% of the fatty acids and this may be caused to the high content of fat in the developed cube. The fixed mineral residue observed in the cube was 16.7%. Ash is the reflection of the total inorganic matter present in the sample. However, the developed cube had low ash content than the mushroom cube (22.5%) by Al Subhi, (2013). The amount of total fiber content in the developed natural curry cube was moderately low 14.7% compared to the mushroom cube, Maggi vegetable cube, chicken cube, beef cube where values were 30.7%, 38.1%, 25.9%, 27.5% respectively according to Al Subhi, (2013) and the values were higher than our final product. Even though Silva et al, (2014) reported pumpkin seed flour enriched cereal bars are rich in high fiber content. Low carbohydrate amount recorded as 14.5% making low carbohydrate containing food ingredient for the nutritionist to recommend over other flavor enhancers like mushroom cube 35.1% carbohydrates. (Al Subhi, 2013).

The pH of the developed cube was 5.5 and it can be classified as a low acid food (pH4.5<). The pH is an important parameter for the determinant of microbial growth as most bacteria grow optimally at about pH 7. The pH level affects chemical and biological reactions with water especially with the ingredients of food products. There are different kinds of organisms that have specific pH levels that may affect food quality in different ways (Gilbor et al, 2013).

Microbial Analysis

The results of microbiological data are presented in Table 4. Microbial contaminations were not detected in the natural curry cube mixture throughout the storage period of two months.

Table 4: Microbial analysis of developed curry cube

Parameter	Interval (Months)	Microbial Count (log CFU/g)
Coliform	0	ND
	1	ND
	2	ND
Yeast/Mould	0	ND
	1	ND
	2	ND
TPC	0	ND
	1	ND
	2	ND

Total plate count levels were less than maximum spoilage limits after one month and two months. The yeast and mold count were zero may be due to the low water activity. Gilbar et al, (2013) reported microorganisms and enzymes which are the causes of food spoilage cannot operate without moisture. Microbes could be introduced cross contamination in the natural curry cube mixture during and after production while processing and handling.

CONCLUSIONS/RECOMMENDATIONS

Treatment three contained a major proportion 70% of pumpkin seed powder and this may have contributed to enhance taste, odor, and other sensory attributes. The cube containing higher amounts of protein and fats with low carbohydrates may be a nutritious product that could replace the flavor enhancing chemical products.

Further research is needed to find the suitable packaging material to increase the shelf life of developed flavor enhancer cube and analyze the fatty acid profile of the final product as the final product contained higher amounts of crude fat.

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