Assessing Consumer Preferences on Characters of Pumpkin (*Cucurbita spp.*)

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ABSTRACT

This study assesses consumer preferences on a number of characteristics of Pumpkin (*Cucurbita spp.*). It consisted two main phases namely phase I and II. In phase I, data collected through a questionnaire based survey conducted with a sample of 300 consumers from Kegalle and Kurunegala districts were used to determine these characters. In Phase II, the Kano analysis was conducted, to classify these characters into Kano dimensions according to the impact of each characteristic on customer satisfaction where the first and third preferences on character were used as functional and dysfunctional forms, respectively. This survey was conducted with a randomly selected sample of 60 consumers from the Kegalle district, in which the graphical and continuous analysis was used. The results from both surveys suggest that low amount of seeds, intermediate orange flesh colour, high flesh thickness (with the proportion of flesh to seed cavity as 2:1), medium level of starchiness and minimum three days of storage period of sliced Pumpkin are important factors to be strictly considered in developing a new variety. The other important characteristics include flattened fruit shape, green colour fruit skin with a yellow colour design, 1-2.5 kg of fruit size, medium level of sweetness, intermediate pericarp thickness (2-3 mm), rounded fruit rib shape and intermediate fruit rib depth. It also important to be considered to incorporate some of these characteristics to increase the consumer demand towards a new variety.

KEYWORDS: Consumer preference, *Cucurbita spp*, Kano analysis, Pumpkin

INTRODUCTION

Pumpkin (*Cucurbita maxima Duch. ex Lam.*) is cultivated throughout India, Sri Lanka and most regions of the world (Jayaweera, 1980). In Sri Lanka Pumpkin grows best in the dry zone and also in the intermediate zone. Anuradapura, Mahaweli H area, Kurunegala, Monaragala, Ampara, Hambanthota, Rathnapura and Badulla are major Pumpkin growing areas in Sri Lanka (Anon, 2004). Table 1 indicates cultivation extent, production and average yield of Pumpkin over the period of year 2002-2004.

Table 1- Cultivation extent, production and average yield of Pumpkin (2002-2004):

Year	Extent (ha)	Production (mt)	Average yield (mt/ha)
2002	6,622	59,578	8.99
2003	7,228	63,830	8.83
2004	6,478	67,352	10.40

Source: Department of Census and Statistics

Pumpkin is popular among Sri Lankans due to its high nutritive value, taste and low agrochemical usage during its cultivation (Jayasinghe and Senarathna, 2003). Pumpkin has high income generating ability with low cost of production and long shelf life of well-matured fruits under room temperature (Anon, 2003).

Recommended variety of Pumpkin by the Department of Agriculture is "Ruhunu". It has uniform shape, small fruits (2-2.5kg), thick pericarp and yellow colour flesh (Anon, 2003). Other than "Ruhunu", many local varieties are also being grown by farmers. However, currently most growers cultivate imported hybrids. Presently the most popular F1 hybrid is "Arjuna", which is better-known as Malaysian variety by the farmers.

Several problems have been encountered with present Pumpkin cultivation. Some problems encountered with imported hybrids are low reliability of seed source, low seed quality and importation of seeds infected with high pest and disease incidences (Fonseka, 2002). Farmers have stated that, their fields were affected destructively by fruit fly (*Bactocera cucurbitae*). Furthermore, they had been stated that Cucumber Mosaic Virus was severe on their cultivation and it was difficult to control (Anon, 2006). Further, local Pumpkin cultivars are under threat of extinction due to introduction of foreign varieties (Dissanayake, 2003). Therefore, development of a new variety that will be suited and well adapted to local conditions will be a better solution to overcome above problems.

Development of a variety is a long-term programme and involves high cost factor. Accordingly, after developing a variety it should be capable to cater high consumer demand over presently available varieties. A major factor, which influences the demand for a product is the customer satisfaction (Kotler, 2003). Hence, it will be possible

to develop a variety with high consumer satisfaction by incorporating consumer preferable characters. Generally farmers are willing to cultivate a variety, which is having high consumer demand. Further, it is important to incorporate resistance against most destructive pests and diseases, especially for the Cucumber Mosaic Virus where the available control measures are not effective.

Characters of Pumpkin vary from one variety to another. For instance, when considering the percentage of Total Soluble Solids (TSS) some varieties have higher percentage of TSS reflecting higher level of sweetness while others have lower percentages reflecting comparatively lower level of sweetness. Hence, the consumer preference on sweetness of Pumpkin is also vary accordingly as some consumers prefer low level of sweetness while others prefer higher level. It is important to determine average consumer preference on characters of Pumpkin before initiating the development work of a variety. This study was carried out with objectives of assessing the consumer preferences on important characters of Pumpkin and classifying those characters to prioritize the effort of incorporating preferable level of those characters into a new variety.

METHODOLOGY

This study was conducted in two phases (i.e. Phase I and Phase II). Consumer preferences on characters of Pumpkin were assessed in Phase I while classifying these characters was done in Phase II.

Phase I: Method of Assessing Consumer Preferences

To assess consumer preferences a survey questionnaire was developed with 15 selected characters of Pumpkin (Table 2). Descriptors for vegetables and condiments (Anon, 1995) was used as the basis for selecting important characters that are having influences on consumer preference Other important characters such as level of sweetness, level of starchiness, etc, that are having direct influences on consumer preference were also included in the questionnaire. Consumers were asked to state their order of preference up to the third choice on categories of each character.

Prepared questionnaire was pre-tested using a sample of 15 consumers. Minor modifications were done in the preliminary questionnaire. Three hundred consumers that were randomly selected from Kegalle (175 respondents) and Kurunegala districts (125 respondents) were personally interviewed through the questionnaire. This survey was conducted during June 2006.

If 50 percent or more than 50 percent of the respondents were selected one category of a character as their first choice, the particular category of that character was selected as most preferable form by the average consumer. If any category of a character was not selected by 50 percent or more than 50 percent of the respondents as their first preference, cumulative percentage of first and second choices were used to select the most preferable form of the particular character. Second and third preferable forms were

Table 2 – Selected characters, their shorten forms and categories of each character of consumer preference survey:

Character	Notation	Categories
1. Level of starchiness	LST	Very low, Low, Medium, High, Very high
2. Fruit shape	FSH	Flattened, Cylindrical, Round, Heart-shaped, Oval-shaped, Elongated form, Pyriform, Other shapes
3. Flesh colour	FCL	Pale orange (a colour referrer to the 12A, 12B, 13A, 13B of the colour chart of the Royal Horticultural Society), Intermediate orange (16A, 16B, 17B, 17C), Dark Orange (22A, 23A, 24A)
4. Flesh thickness	FTH	Thin (flesh: seed cavity = 1:2), Intermediate (flesh: seed cavity = 1:1), Thick (flesh: seed cavity = 2:1)
5. Fruit size	FSZ	< 1 kg, 1 – 2.5 kg, 2.5 – 5 kg, 5 – 7.5 kg, >7.5 kg
6. Amount of seeds	ASE	No seeds, Low amount of seeds, Intermediate amount of seeds, High amount of seeds
7. Level of sweetness	LSW	Very low, Low, Medium, High
8. Pericarp thickness	PTH	Thin (< 2 mm), Intermediate (2 – 3 mm), Thick (>3 mm)
9. Predominant fruit skin colour	PSC	Green colour, Cream colour, Yellow colour, Orange colour, Other colours (i.e. Red colour, Ash colour etc,)
10. Secondary fruit skin colour	SSC	Yellow colour, Cream colour, Green colour, Other colour (white colour, Orange colour, etc,)
11. Design produced by secondary fruit skin colour	DSC	No secondary skin colour, Dotted (Speckled), Spotted, Striped, Streaked, Others
12. Fruit rib shape	FRS	No ribs, Rounded, Intermediate shape, V – Shaped
13. Fruit rib depth	FRD	Absent, Superficial, Intermediate, Deep
14. Minimum storage life of sliced Pumpkin	SLF	< 3 days, 3 days, >3 days
15. Presence of green colour stripe on flesh closed to the pericarp	GCS	Present, Absent

also selected by considering percentage preference of their first choice, cumulative percentage of their first and second choices or cumulative percentages of first, second and third choices accordingly.

Phase II: Method of Categorizing Characters through the Kano Analysis

Consumer requirements can be classified mainly in to four categories namely "One-dimensional", "Attractive", "Must-be" and "Indifferent" requirements through the Kano analysis. In the Kano diagram (Figure 1), the line going through the origin at 45-degree angle indicates the nature of "One-dimensional" requirements. Consumer satisfaction is simply proportional to the functionality of "One-dimensional" requirements, i.e. the consumer is more satisfied with a more functional product and less satisfied with a less functional product. The "Must-be" curve indicates characters that result in dissatisfaction when not fulfilled but the consumer satisfaction never rises above neutral when it is fulfilled. (i.e. if a product has preferable forms of "Must-be" characters the consumer will be neutral. However, lack of preferable forms will quickly dissatisfy the consumer). According to Figure 1, lack of "Attractive" features leaves a consumer basically neutral. However, having preferable forms of "Attractive" characters quickly increases the consumer satisfaction. Indifference will be plotted on Figure 1, roughly along the horizontal axis. The consumer is neither satisfied nor dissatisfied whether the variety is having preferable forms of "Indifferent" characters or not (Berger *et al.*, 1993).

Other categories of the Kano analysis are "Questionable" and "Reverse" categories. If any character receives a significant number of "Questionable" (Q) scores indicate there is a confusion of consumers with the question. If the majority of scores for a character is "Reverse" (R), indicates the respondents favor the character in its' opposite manner which is stated by the question. (Berger *et al.*, 1993).

The return that could be obtained by fulfilling a requirement should guide the effort of investing to fulfill it. The Kano survey results will dictate what

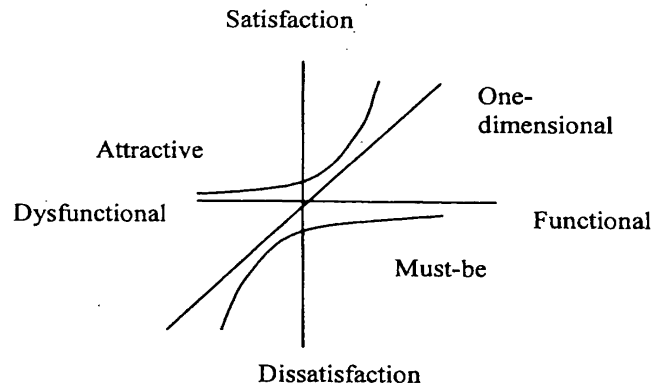

Figure 1 – The Kano diagram:

should be included in a product. The general guideline is to seek to fulfill all "Must-be" requirements, be competitive with market leaders on "One-dimensional" requirements and include some differentiating "Attractive" elements (Berger *et al.*, 1993).

The Kano analysis was used to confirm and categorize consumer preferences discovered through the consumer preference survey in Phase I. Fifteen questions were included in the Kano questionnaire with two parts per each question namely functional and dysfunctional forms. The functional form in each pair of questions for a requirement should refer to a situation in which the requirement is met. Dysfunctional form in each pair should refer to the case where the requirement is not met (Berger et al., 1993). For this study, first preferences of selected characters from analyzed data in Phase I (which are shown in preference 1 in Table 5) were referred in functional form of each pair of question for a particular character while third preference of each character (which are shown in preference 3 in Table 5) was referred in dysfunctional form of each question. Third preference was selected to have a contrast difference of dysfunctional form from the functional form of the question. However, in situations where a particular character has binary answers (e.g. presence or absence of the character), functional form for the character referred the positive answer (e.g. presence of the character) while dysfunctional form referred the negative answer (e.g. absence of the character). To each part of the question, the respondent can answer in one of five different ways. For instance, two parts of a question and their standard answers have been indicated in figure 2.

Sixty consumers that were randomly selected from Kegalle district were personally interviewed through the Kano questionnaire. The Kano survey was conducted during first two weeks of August 2006.

Using the Kano evaluation table (see Table 3) is a simple method of categorizing characters into

Functional form of the question

If a new Pumpkin variety is having flattened shaped fruits how do you feel?	1. I like it that way 2. It must be that way 3. I am neutral 4. I can live with it that way 5. I dislike it that way
If a new Pumpkin variety is having heart shaped fruits how do you feel?	1. I like it that way 2. It must be that way 3. I am neutral 4. I can live with it that way 5. I dislike it that way

Dysfunctional form of the question

Figure 2 – A pair of questions in the Kano Questionnaire:

Table 3 - Kano evaluation table:

Customer requirements → / ↓		Dysfunctional				
		1. Like	2. Must-be	3. Neutral	4. Live with	5. Dislike
Functional	1. Like	Q	A	A	A	O
	2. Must-be	R	I	I	I	M
	3. Neutral	R	I	I	I	M
	4. Live with	R	I	I	I	M
	5. Dislike	R	R	R	R	Q

Customer requirement is A: Attractive I: Indifferent O: One-dimensional
R: Reverse M: Must be Q: Questionable

Kano dimensions (Berger *et al.*, 1993). Each completed questionnaire in the Kano survey was processed according to the Kano evaluation table. Further, attempts were taken to categorize characters using graphical and continuous analysis as described by Berger *et al.*, (1993). Theory and the method behind establishing of the basic plot of graphical and continuous analysis have been described below.

If there are Q pair of questions in the Kano questionnaire, $j = 1,2,3... Q$ and if N number of respondents is answered in the survey, $i = 1,2,3... N$. In this study a self-stated importance questionnaire was not used. Thus, there are two scores as Functional and Dysfunctional that can be coded as follows:

Functional: Y_{ij} = -2 (Dislike), -1 (Live with), 0 (Neutral), 2 (Must-be), 4 (Like)

Dysfunctional: X_{ij} = -2 (Dislike), -1 (Live with), 0 (Neutral), 2 (Must-be), 4 (Like)

X and Y take on the values -2, -1, 0, 2, and 4 only. Y values and X values for each question were calculated over N number of respondents. For instance, if respondent number 8, answers as "I like it that way" for functional form and "Neutral" for dysfunctional form for character number 6, then,

$$Y_{8,6} = 4, \qquad X_{8,6} = 0$$

The average of the X (dysfunctional) and Y (functional) answers across all respondents were calculated for all questions, j = 1, 2, 3 ...Q , using following equations.

$$X\,average\,[j] = \frac{\sum_i X_{ij}}{N}, Y\,average\,[j] = \frac{\sum_i Y_{ij}}{N}$$

The pairs of coordinates representing the average responses to each of the Kano questions were plotted on a grid (see figure 7) that is the basic plot of graphical and continuous analysis. In the basic plot the square where X average and Y average range from 0 to 4 is naturally divided into quadrant, with the prototypical "Attractive", "One-dimensional", "Must-be" and "Indifferent" points considered to be at the four corners. The nature of each character were clearly delineated by the quadrant into which that point was fallen.

RESULTS AND DISCUSSION

Descriptive Statistics

Descriptive statistics of selected samples of respondents in both surveys are shown in Table 4.

Table 4 – Descriptive statistics on samples of Phase I and Phase II:

Demographic character		Phase I		Phase II	
Character	**Categories**	**Number of respondents**	**% of respondents**	**Number of respondents**	**% of respondents**
Age	18 – 35 yrs.	70	23.3	17	28.3
	36 – 55 yrs.	163	54.3	38	63.3
	>55 yrs.	67	22.3	5	8.3
Gender	Female	215	71.7	53	88.3
	Male	85	28.3	7	11.6
Level of education	Primary	103	34.3	17	28.3
	Secondary	136	45.3	41	68.3
	Tertiary	61	20.3	2	3.3
Location	Rural	135	45.0	16	26.7
	Semi-Urban	141	47.0	24	40.0
	Urban	24	8.0	20	33.3
Income	< Or = 15,000	225	75.0	21	35.0
	>15,000 and < 25,000	57	19.0	35	58.3
	> Or = 25,000	18	6.0	4	6.7

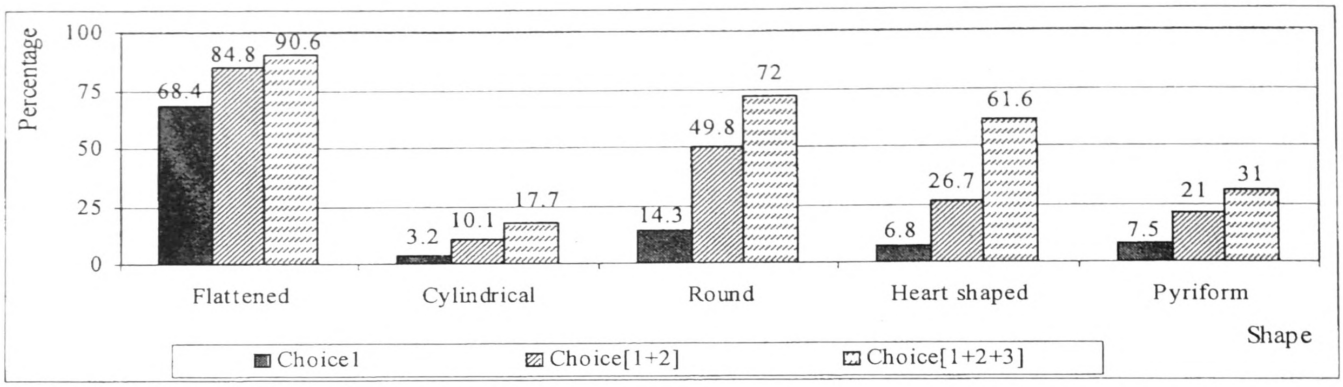

Figure 3 - Percentage preferences on fruit shape:

Phase I: Descriptive Statistics of Consumer Preference Survey

Percentage first preference several important characters has been indicated as [Choice 1] of Figure 3,4,5 and 6 respectively while [Choice 1+2] represent cumulative percentages of first and second preferences of respondents. Cumulative percentage of first, second and third preferences represent by [Choice1+2+3] of Figure 3 and 5.

Flattened fruit shape was preferred by 68.4 percent of respondents as their first preference. First preference of respondents was not reached even up to 25 percent for any other fruit shapes (Figure 3). Therefore, to select second preferable shape, cumulative percentages of first and second preferences were used. Round shape was preferred by 49.8 percent of respondents while 26.7 percent and 21 percent of respondents preferred heart shape and pyriform shape respectively as their first or second preference (Figure 3). Therefore, round shape was selected as second preferable shape. To select third preferable shape cumulative percentage of first, second and third preferences were used. Heart shape was preferred by 61.6 percent of respondents while 31 percent preferred pyriform shape. Therefore, Heart shape was taken as the third preferable shape. Accordingly, most respondents were willing to have flattened shape in a new variety while round and heart shapes were selected as second and third preferable shapes respectively (Table 5).

Percentage first preferences of respondents for intermediate flesh colour (40.7 percent) and dark flesh colour (39.3 percent) were closed to a tie among each other (Figure 4). Cumulative percentages of first and second preferences were used to differentiate first and second preferable flesh colours. Intermediate flesh colour has been selected by 99 percent of respondents as their first or second preferences while 57.3 percent of respondents were selected dark flesh colour as their first or second preference indicating most preferable flesh colour was intermediate colour followed by dark flesh colour. Third preferable flesh colour was pale colour that was selected by 43.7 percent of respondents as their first or second preference.

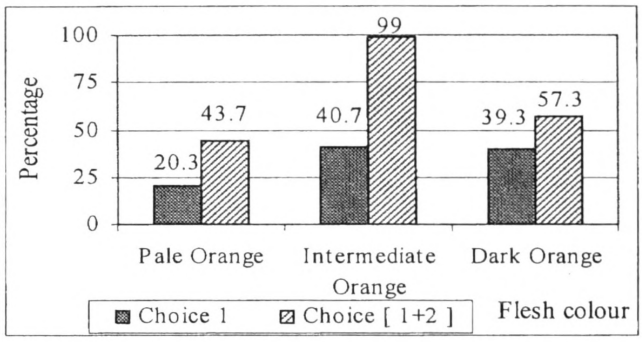

Figure 4 - Percentage preferences on flesh colour:

Percentage preferences on the level of starchiness and flesh thickness are given in Figure 5, and 6 respectively. Selection of first, second and third preferences of these characters are also same as above.

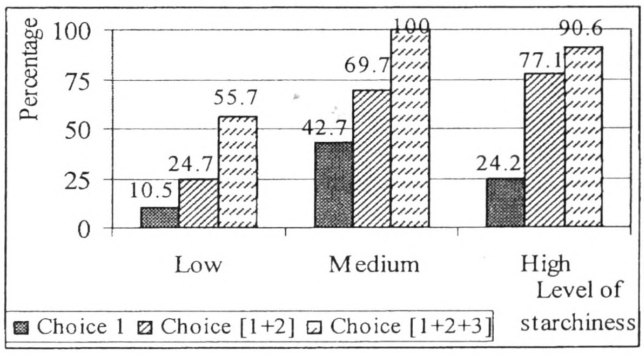

Figure 5 – Percentage preferences on levels of starchiness:

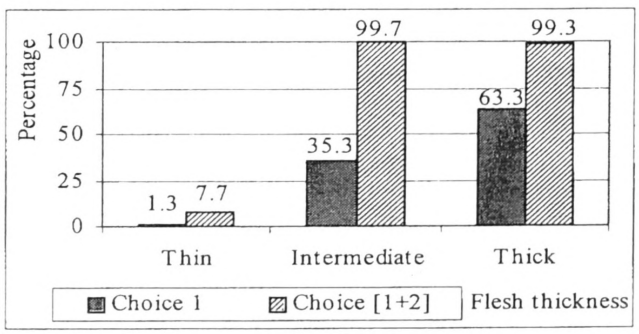

Figure 6 – Percentage preferences on flesh thickness:

Table 5 - Consumer preferable levels or forms of characters of Pumpkin:

Character	Preference 1	Preference 2	Preference 3
1. Level of starchiness	Medium level (42.7)*	High level (24.2)*	Low level (10.5)*
2. Fruit shape	Flattened (68.4)*	Rounded (49.8)**	Heart-shaped (26.7)**
3. Flesh colour	Intermediate Orange (99)**	Dark Orange (57.3)**	Pale Orange (43.7)**
4. Predominant fruit skin colour	Green (68.3)*	Yellow (59.9)**	Cream (38.3)**
5. Secondary fruit skin colour	Yellow (58.7)*	Cream (84.1)***	Green (73.2)***
6. Design produced by secondary fruit skin colour	Spotted (70.2)**	No secondary colour (56.4)**	Stripped (37.3)**
7. Fruit size	1 - 2 .5 kg (47.3)*	< 1kg (46.0)** and 2 .5 - 5 kg (48.7)**	5 -7 .5 kg (13.0)**
8. Flesh thickness	Thick (63.3)*	Intermediate (35.3)*	Thin (1.3)*
9. Amount of seeds	Low (89.0)**	Medium (73.0)**	No seeds (29.0)**
10. Level of sweetness	Medium (49.0)*	Low (90.0)**	Very low (33.8)**
11. Pericarp thickness	Intermediate (51.7)*	Thin (30.0)*	Thick (18.3)*
12. Fruit rib shape	Rounded (69.0)*	Intermediate (54.3)**	No ribs (40.3)**
13. Fruit rib depth	Intermediate (54.7)*	Superficial (70.7)**	No fruit ribs (23.7)**

Note: Percentage preference or percentage cumulative preference has been shown within brackets.
* - selected by considering first percentage preference. ** - selected by considering cumulative percentage of first and second preferences. *** - selected by considering cumulative percentage of first, second and third preferences.

Presence of green colour band on flesh adjacent to the pericarp of the sliced Pumpkin was preferred by 59.3 percent of respondents while 40.7 percent of respondents were not considering its presence.

As available varieties are having very low shelf life of sliced Pumpkin under room temperature, 43.9 percent of respondents were opted have a minimum three days of storage period for sliced pieces of a new Pumpkin variety.

Consumer preferable forms of characters of Pumpkin are given in Table 5.

Phase II: Results from the Kano Analysis

Categorization of characters shown in Table 6 referred the Kano Evaluation Table. Two or more categories of three characters namely fruit rib shape (FRS), fruit rib depth (FRD) and the level of starchiness (LST) are close to tied (Table 6) indicating less strength of the categorization of these characters even though they have been assigned into single categories. However, none of the characters investigated was fallen into "Reverse" or "Questionable" categories. Fifteen characters could be clearly assigned into Kano categories by using the graphical and continuous analysis. The basic plot of graphical and continuous analysis is shown in Figure 7.

Amount of seeds was the only "Must-be" character, which had fallen into the bottom-right quadrant of the basic plot (see Figure 7). In Pumpkin, the level of starchiness is a major factor that influences the consumer demand. According to the consumers' view, the starchiness of a new Pumpkin variety will be low if it will not be having seeds. Being a "Must-be" character absence of seeds (as it was taken as the dysfunctional form of the question) will quickly dissatisfy the consumer. Consumers were not willing to have a variety with out seeds.

Table 6 – Categorization of characters using the Kano Evaluation Table:

Character	A%	M%	O%	I%	R%	Q%	Grade
LST	10	40	37	12	0	2	M
FSH	35	18	18	23	5	0	A
FCL	22	38	22	15	2	2	M
FTH	3	18	35	8	5	0	M
FSZ	37	15	13	23	10	2	A
ASE	18	35	18	20	5	3	M
LSW	28	23	10	12	23	3	A
PTH	20	18	28	20	13	0	O
PSC	18	15	17	32	8	2	I
SSC	42	5	15	28	5	5	A
DSC	13	3	8	50	22	3	I
FRS	25	13	27	30	5	0	I
FRD	28	12	25	27	8	0	A
SLF	23	7	65	5	0	0	O
GCS	20	15	13	50	2	0	I

Flesh thickness, level of starchiness, flesh colour and storage life of sliced Pumpkin pieces had fallen into the upper right quadrant of the basic plot indicating they should be treated as one- dimensional characters. Being "One-dimensional" characters, consumers will be more concerned on the characters of the flesh. Therefore, it is important to incorporate thick flesh and intermediate orange colour flesh in to a new variety. Inability to storing sliced Pumpkin pieces even for 3 days under room temperature was indicated as a main problem especially by respondents from rural areas. This may be the reason of including the shelf life of sliced Pumpkin pieces under the "One-dimensional" category.

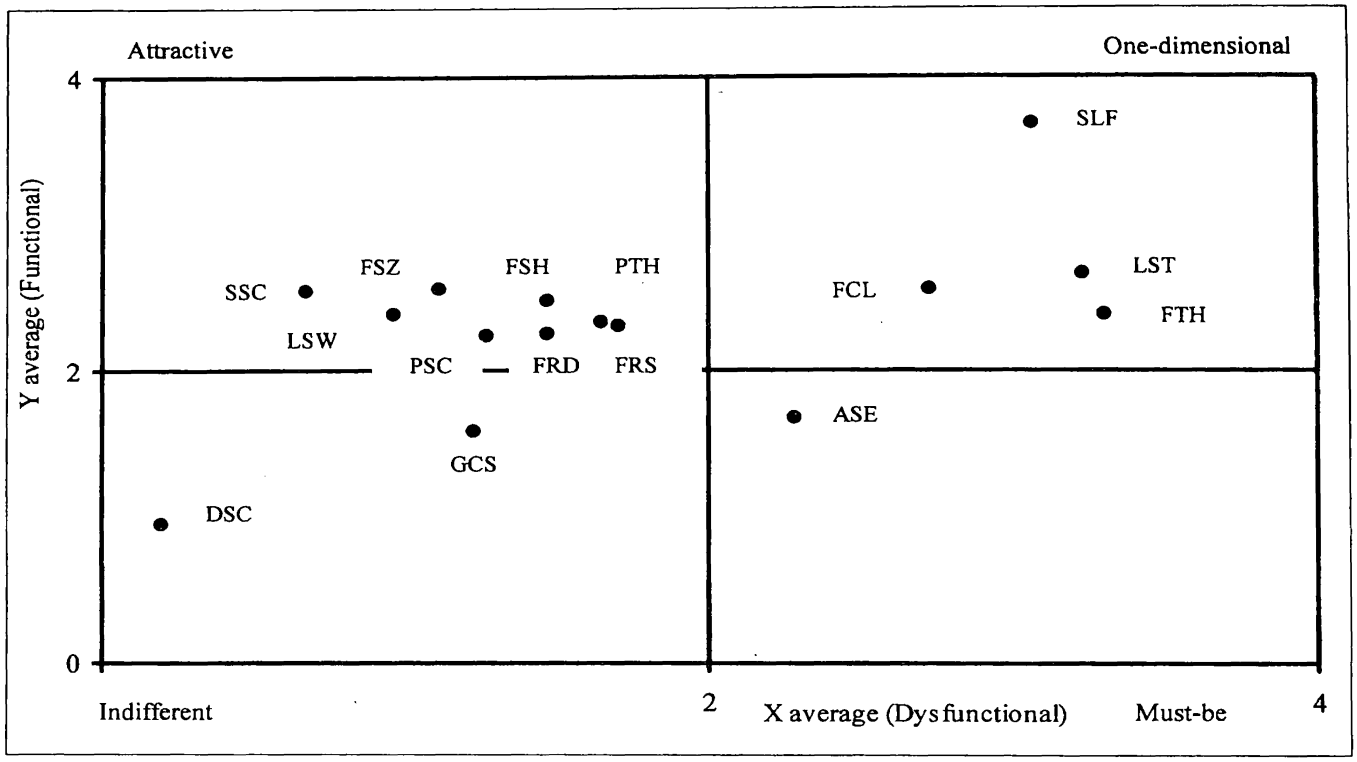

Figure 7 - The basic plot of graphical and continuous analysis:

Predominant fruit skin colour, secondary fruit skin colour, the level of sweetness, fruit size, fruit shape, pericarp thickness, fruit rib shape and fruit rib depth are fallen into upper left quadrant indicating "Attractive" nature of these characters. Most of them are closely related with the outer appearance of the fruit. If it is possible to incorporate preferable forms of these characters (as indicated in Table 5) into a single variety, it will increase the consumer satisfaction resulting increased demand to the variety.

Two characters namely, presence or absence of a green colour band on the flesh adjacent to the pericarp and the design produced by secondary fruit skin colour are "Indifferent" characters that had been fallen into bottom-left quadrant in Figure 7. It is not necessary to focus on these two characters in a varietal development programme as they belong to the "Indifferent" category.

CONCLUSIONS

Acceptance or rejection of a variety is mainly depending on the consumer perceived quality of a variety. Therefore, the breeder should know the consumer requirements, prior to the development of a variety. In developing a new variety the breeder should incorporate low amount of seeds into a new variety. Intermediate orange colour flesh, high flesh thickness (with the proportion of flesh to seed cavity as 2:1), medium level of starchiness and extended shelf life of sliced Pumpkin (minimum three days) will allow a breeder to develop a competitive variety among present available varieties. Furthermore, it is important to incorporate first preference of some "Attractive" characters that were flattened fruit shape, green colour fruit skin with a yellow colour design, 1-2.5 kg of fruit size, medium level of sweetness, Intermediate pericarp thickness (2-3 mm), rounded fruit rib shape and intermediate fruit rib depth into a new variety to attract consumers towards a new variety.

Further sorting of characters within each category will be possible if a self-stated importance questionnaire (Berger et. al., 1993) can be used in parallel with the Kano survey.

ACKNOWLEDGEMENTS

The authors wish to express their gratitude to Dr. J. D. H. Wijewardana, Deputy Director (Research) and all the staff members of the Regional Agricultural Research and Development Center, Makandura, Dr. Gamini Samarasinghe and other staff members of Plant Genetic Resource Center, Peradeniya and Ms. Dinum Perera, Assistant Lecturer of Department of Agribusiness Management in Wayamba University of Sri Lanka, for their valuable assistance for the success of this study.

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