Path Analysis for Potato crisps

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Abstract

The present paper focuses on path analysis in potato crisps. Five characters namely taste, texture, color, flavor and overall acceptability of potato crisps prepared from eighteen potato varities were evaluated for variability and path analysis. Positive and high regression estimate (0.816) of taste and acceptability suggests that taste is the most important character for determining the acceptability of crisps. The results of path analysis also showed that taste has high and direct effect (0.885) on the acceptability of crisps and that it could be considered as the selection critera for evaluating the sensory parameters of potato crisps. Some important goodness of fit measures such as chi square statistic (CMIN), root mean square index (RMR) and goodness of fit index(GFI) were computed to asses whether the model is good fit or not. The value of GFI (0.72) indicated a good fit model.

Keywords: *Path analysis, Direct effect, Indirect effect*

Introduction and Background

Potato (*Solamum tuberosum* L.) is an annual crop from family Solanaceae and ranked fourth in the world after wheat, rice and maize. Potato, is an annual cool season crop, which need most favorable temperature ranging from 16ºC to 20 ºC for the excellent growth of tubers (Mathur, 2003). Pakistan is the seventh largest potato producing country in the world. The production of potatoes during the year 2014-15 increased by 6.3 percent (GoP,2014).

Sometimes it is important to assess the direct and indirect relationship among various characters of interest. In this case simple correlation doesn't give good results and it's better to do path analysis.

The use of Path coefficient analysis has been found in literature to determine direct and indirect effects of independent variables on potato yield (Tsegaye *et al***,** 2006**).** A study was conducted by(Sattar *et al*, 2007) to determine correlation and path analysis in 28 potato genotypes . Lamboro *et al* 2014) used path coefficient analysis and correlation in 18 potato accessions for studying association among potato yield and its traits. In another study by (Tuncturk and Çiftçi, 2005) correlation and path coefficient analysis and its application in potato yield was

determined. Keeping in view the significance and scope of path analysis present study is designed in collaboration with Plant Genetic and Research Institute (PGRI) and Food Science and Product Development Institute (FSPDI) of National Agricultural Research Centre (NARC) to find direct and indirect association among sensory attributes of potato crisps.

Material and Methods

Data on sensory attributes such as taste, texture, color, flavor and overall acceptability of potato crisps made from eighteen different potato genotypes were collected from plant genetic and resource program (PGRP). AMOS software was used for conducting path analysis.Initially path diagram was created in AMOS to show the direct and indirect paths of dependent and independent variables. Some model fit measures including chi square statistic (CMIN), root mean square index (RMR), goodness of fit index (GFI) were computed to asses goodness of fit and distribution of data.

Results and Discussion

Table 1.Standardized Regression Weights

			Estimate
flavor	<---	texture	.749
flavor	<---	color	-.465
flavor	<---	taste	-.262
acceptability	<---	taste	.816
acceptability	<---	texture	.180
acceptability	<---	flavor	.040
acceptability	<---	color	-.010

The table above describes the regression weights. The singal path here shows dependency of one variable upon the other. Flavor is the intermediate varialble and acceptibility is dependent or endogeneous variables and taste, color, texture and flavor are independent or exogeneous variables. When texture goes up by 1 standard deviation, flavor increases by 0.749 standard deviation. Color has negative estimate value implying that if one unit standard deviation is increased in color will reduce the flavor by 0.465 standard deviation. Similarly taste negative estimate with regards to flavor that is by one standard deviation increase in taste will reduce the flavor by 2.62 standard deviation. The variables taste, texture and flavor have positive estimtes 0.816, 0.180 and 0.040 respectively. Taste has highest estimate indicating that this variable is the most important and one standard deviation increase in taste, will raise the acceptability of crisps by 0.830 standard deviation.

Correlation between the exogeneous variables

			Estimate
taste	<-->	Texture	.779

The correlation between taste and texture is 0.779 which is positive and close to 1. This implies that the exogenous variables are positively correlated.

Table 2. Total Effects

	color	texture	taste	flavor
flavor	-.465	.749	-.262	.000
acceptability	-.028	.210	.805	.040

The standardized total (direct and indirect) effect of **color** on **flavor** is -.465. That is, due to both direct (unmediated) and indirect (mediated) effects of **color** on **flavor**, when **color** goes up by 1 standard deviation, **flavor** goes down by 0.465 standard deviation. Similary the total effect of texture on flavor is 0.749 , taste onn flavor is -2.62. The total effects of color, texture, taste and flavor on acceptability are found in the same way. Direct and indirect effects are shown in the table 3 and table 4.

Table 3. Direct Effects from Path Analysis

	color	texture	taste	flavor
flavor	-1.044	1.790	-.590	.000
acceptability	-.010	.207	.885	.019

Table 4. Indirect Effects from Path Analysis

	color	texture	taste	flavor
flavor	.000	.000	.000	.000
acceptability	-.020	.034	-.011	.000

Model Fit Summary

CMIN

Model	NPAR	CMIN	DF	P	CMIN/DF
Default model	13	19.501	2	.000	9.751
Saturated model	15	.000	0		
Independence model	5	95.884	10	.000	9.588

NPAR is the number of parameters in the model. In the saturated (just identified) model there are 15 parameters – 5 variances(one for each variable) and ten path coefficients. For the default model there are 13 parameters – we dropped two paths. For the independence model all paths have been dropped and we have 5 parameters. CMIN is the chi square statistic comparing the tested model with the saturated model. CMIN/df is the relative chi-square which is an index of

how much the fit of data to model has been reduced by dropping one or more paths. A rule of thumb is that if this index exceeds 2 or 3 implies that we have dropped too many paths.

RMR, GFI

Model	RMR	GFI	AGFI	PGFI
Default model	.412	.786	-.608	.105
Saturated model	.000	1.000		
Independence model	.348	.377	.065	.251

RMR is the root mean square index which determines the amount of change from the variances of the tested model to that of actual and observed variances. Smaller value of RMR is better. GFI is the goodness of fit index and it tells about the proportion of variance explained by the model. It should be close to 1 for a goodfit model. In this case GFI value is 0.786 that means the model is good fit. AGFI is the adjusted goodness of fit index. PGFI is the parsimony goodness of fit index and in our data it is larger for the tested model as compared to independence model**.**

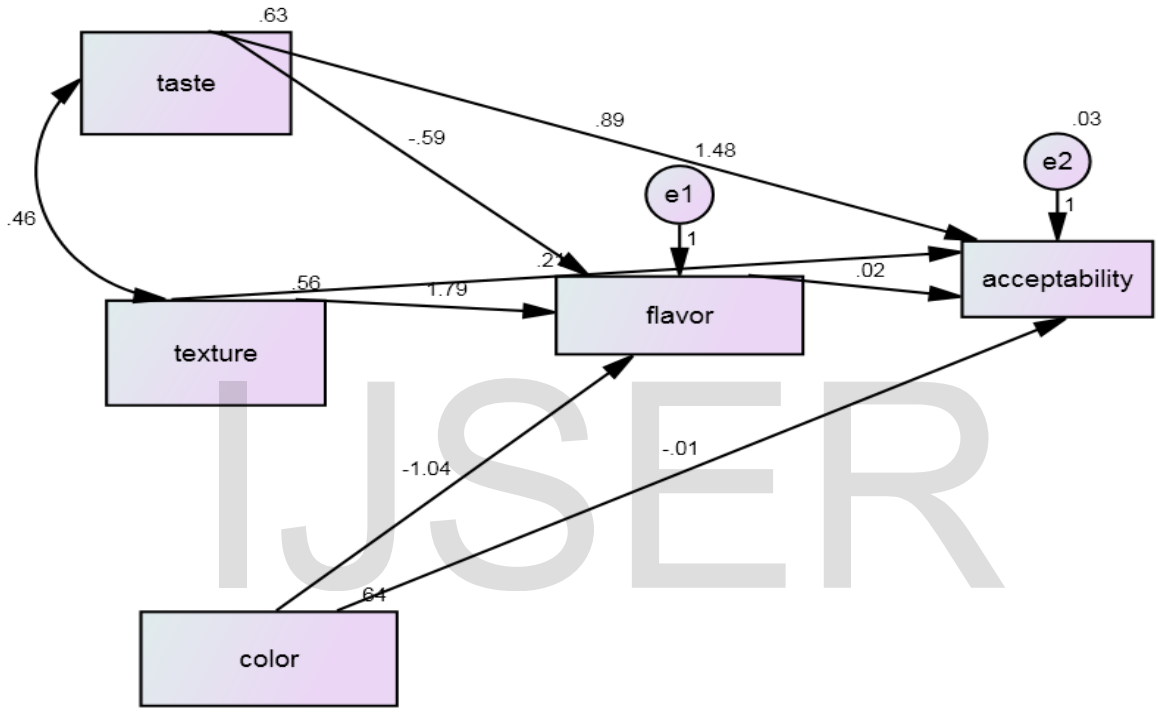
These goodness of fit indices compare the independence model with the tested model rather than the saturated model. For our data, that is (95.884-19.501)/95.884 = 0.79. This value indcates that the model fits satisfactorily to data. The comparative fit index ranges from 0 to 1 and the value close to 1 indicates good fit**.**

Literature show studies about the sensory attributes of potato where mostly descriptive statistical analysis, correlation analysis and analysis of variance have been carried out to study relationships among the attributes. For instance, Yodkraisri, and Bhat, (2012) have used analysis of variance approach for quality evaluation of deep fried chips. However the present study lays emphasis on the use of path analysis to study the sensory properties of potato and also the direct effects of these parameters on the acceptability of crisps.

Conclusion

Among all of the sensory parameters studied taste had positive direct effect on the acceptability of potato crisps. Some important goodness of fit measures such as chi square statistic (CMIN), root mean square index (RMR) and goodness of fit index(GFI) were computed to asses whether the model is good fit or not. The value of GFI (0.786) indicated a good fit model.

Figure: Path diagram showing relationship among dependent and independent variables



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