

Development of Framework for a Comparative Study of Long Pepper (Piper Longum) and Black Pepper (Piper Nigrum) through Organoleptic Evaluation

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Abstract:

Indian cuisine relies heavily on peppers, particularly black pepper (piper nigrum), but long pepper (piper longum) can also be used. An intriguing spice with a moderate flavour and fruity undertones, long pepper is indigenous to India and offers a wealth of health advantages. This study was conducted to analyse the flavour profiles and determine which pepper of the two, long pepper and black pepper is most accepted by respondents when used in food items. Using Paneer Pepper Fry and Pepper Rasam, two recipes that had long pepper and black pepper as main ingredients, a survey was conducted using organoleptic analysis. The sample size initially was 74, out of which 69 were found to be usable data. The study adopted a structural equation model and the framework was tested using GFI, AGFI, RMSEA, NFI, and other parameters to analyse the data. For long pepper, a positive and extremely significant correlation was established in terms of taste, appearance, flavour, aroma, mouthfeel, aftertaste and overall acceptance. This study paves the path for additional research that examines the nutritional advantages of the two peppers.

Keywords: Structural Equation Model, Organoleptic Evaluation, Consumer Perception, Piper Longum

1. Introduction

Long Pepper - Derived from the Tamil word pippali, pepper is an Indigenous ingredient native to India, is a well-known spice from the times of Ancient India, as pippali, piper longum is a fascinating spice that has been found in the books of Ayurveda. For generations, people have prized this thin, finger-like spice for both its culinary and therapeutic qualities. It is a spice worth trying because of its nuanced flavour and interesting history. Long pepper is a fruit that is dried before consumption just like black pepper. Its characteristics chemically are similar to piper nigrum - black pepper but are of distinct fruitiness in flavour that are less harsh on the palette creating a sweeter spicy yet a pungent experience

than. The flavour of long pepper is both familiar and unique. It has a peppery, black pepper-like heat at first, but it soon gives way to layers of sweetness, warm spice, and delicate floral notes. It is a versatile spice that works well in both savoury and sweet applications because it frequently has hints of nutmeg, cinnamon, and cardamom. For people who prefer strong flavours, its heat is especially tempting because it is more intense and persistent than black pepper. The after taste of the long pepper has a cooling effect like menthol or tobacco unlike black pepper that stings and leaves a certain uneasiness. Native to the Indian subcontinent, especially the states of Bengal and Assam, long pepper grows well in tropical climes. The plant is a flowering vine that is a member of the Piperaceae family, which also includes white and black pepper. Long pepper has a significant historical role. Because of its strong flavour and scarcity, it was a highly valued spice in antiquity and frequently cost more than black pepper. It was a mainstay of Roman cooking and one of the first spices to make the journey westward from India to Europe via trade routes like the Silk Road. Long pepper was considered a luxury item, denoting wealth and position, and was used in a variety of Roman recipes, such as savoury sauces and spicy wines. Long pepper was still highly prized in mediaeval Europe and was commonly used in spice mixtures and therapeutic concoctions. When black pepper became more widely available, it eventually lost its prominence since it was simpler to grow and transport. Long pepper has been valued in traditional medical systems, especially Ayurvedic traditions, in addition to its culinary uses. It is well-known for its warming qualities and is thought to increase metabolism, improve appetite, and stimulate digestion. Coughs, colds, asthma, and digestive problems have all been treated with long pepper. According to recent research, it includes bioactive substances with anti-inflammatory, antibacterial, and antioxidant qualities, such as piperine. The flavour and historical importance of long pepper are both remarkably nuanced. Its lasting significance is highlighted by its influence on traditional foods and medical procedures. Long pepper is still a gem for anyone looking to broaden their culinary skills and delve deeper into the history of spices, even though it is less prevalent than its black pepper sibling today. Long pepper urges us to rediscover a once-prized treasure of the spice world, whether it is added to a warming tea, used in a thick stew, or dusted over desserts.

2. Literature review

2.1 Pepper – The King of Spices

In many nations, particularly India, spices have long been utilized as a necessary component in food preparation. (Padakatti and Meti, n.d.) Spices can be added to food either separately or in combination to provide flavor, color, and scent. (Sugasini et al., 2018). In the culinary profession, pepper is referred to as the "King of Spices" and is used to improve the taste and consistency of food. Its chemical makeup determines its distinctive scent.

2.2 Historical and Cultural significance of long pepper

Long pepper, or "Pippal" in Sanskrit, is a necessary medicinal spice. It belongs to the Piperaceae family and is native to South and Southeast Asia. Earlier in Europe, especially the Roman Empire loved using piper longum extensively in their cuisine due to their distinct dimension towards eating experiences. (Hosking, 2010) Long pepper, which is less costly than black pepper, is used as an

adulterant of ground black pepper.(Kumar et al., 2011). To create flavor components, gastronomes must understand the chemistry and history of spices. It continues to be utilized as a raw material in several sectors today and is included as a touristic product in travel-related activities. In terms of gastronomy, spices are thought to be the cuisine's best-kept secrets because they enhance flavors and provide a genuine experience. (Özbay and Uçkan Çakır, 2022)

2.3 Components of Pepper

Pepper has been shown to possess a range of anti-microbial and anti-oxidant properties, as well as a range of other putative health benefits. (Spence, 2024). There are several biologically active components in pepper like monoterpenes and other compounds (Meghwal & Goswami, 2013). The study of the plant *Piper longum* showed that it contains several important pharmacological and therapeutic components that are used in Ayurvedic medicine. It is a plant with significant economic and commercial value, and its potential as a bioavailability enhancer can be investigated in several formulations. (Khandhar et al., 2010)

2.4 Medicinal Benefits of Piper Longum

A foundation for investigating potential causal relationships between diet and health as well as the prospection of therapeutic molecules from food ingredients is provided by the crucial role that spices play in creating distinctive meal pairings in Indian cuisines and their well-established medicinal potential (Jain et al., 2015). Indian long pepper, a traditional herb with promising anti-cancer properties may help develop more effective drug delivery methods(Srinivasan, 2015). *Piper Longum* fruit can be used as a naturally occurring substitute for pharmaceuticals and supplements that aim to prevent and treat liver damage. (Satasiya et al., 2021).

Widely used in Ayurveda, *Piper Longum* of long pepper has therapeutic properties and is advised by Ayurvedic doctors for a variety of illnesses (Singh & Upadhyaya, 2015). *Piper longum* are superior options in terms of their antidiabetic properties(Rajeshkumar et al., 2022).*Piper Longum* or long pepper has shown great prominent impact over diseases like depression, cancer, obesity, etc and, it's also shown that it is capable to shield against radiations and bacterial infections.

The plant is more beneficial to humans because of its unique effects(Kumar et al., 2010) Given the deadly side effects and skyrocketing expense of modern medications, spices and their active ingredients provide a strong promise for the creation of unique, inexpensive, and safe medications to treat chronic illnesses(Kunnumakkara et al., 2018). Each spice has a potentially useful quality of its own, and there's a chance that they could work in combination to enhance their culinary and health-related potential. (Viuda-Martos et al., 2010)

3. Methodology

The study adopted a quantitative research method to analyse the data. A 5 point Likert Scale Questionnaire was developed to collect information from consumers through Organoleptic Evaluation. The study involved 74 respondents, only 69 had usable data. The data was analysed statistically using SPSS statistical software and AMOS to develop a model using Structural Equation Model.

4. Results and Findings

H1: The addition of Black Pepper in paneer pepper dry has a significant influence on Appearance, Aroma, Taste, Mouthfeel, aftertaste, and Overall Acceptability.

H2: The addition of Long Pepper in Paneer Pepper dry has a significant influence on Appearance, Aroma, Taste, Mouthfeel, Aftertaste, and Overall Acceptability.

H3: The influence of long pepper on Appearance, Aroma, Taste, Mouthfeel, Aftertaste, and Overall Acceptability is higher than Black Pepper in Paneer Pepper Dry.

H4: The addition of Black Pepper in Pepper Rasam has a significant influence on Appearance, Aroma, Taste, Mouthfeel, Aftertaste, and Overall Acceptability.

H5: The addition of Long Pepper in Pepper Rasam has a significant influence on Appearance, Aroma, Taste, Mouthfeel, Aftertaste, and Overall Acceptability

H6: The influence of long pepper on Appearance, Aroma, Taste, Mouthfeel, Aftertaste, Overall Acceptability is higher than Black Pepper in Pepper Rasam.

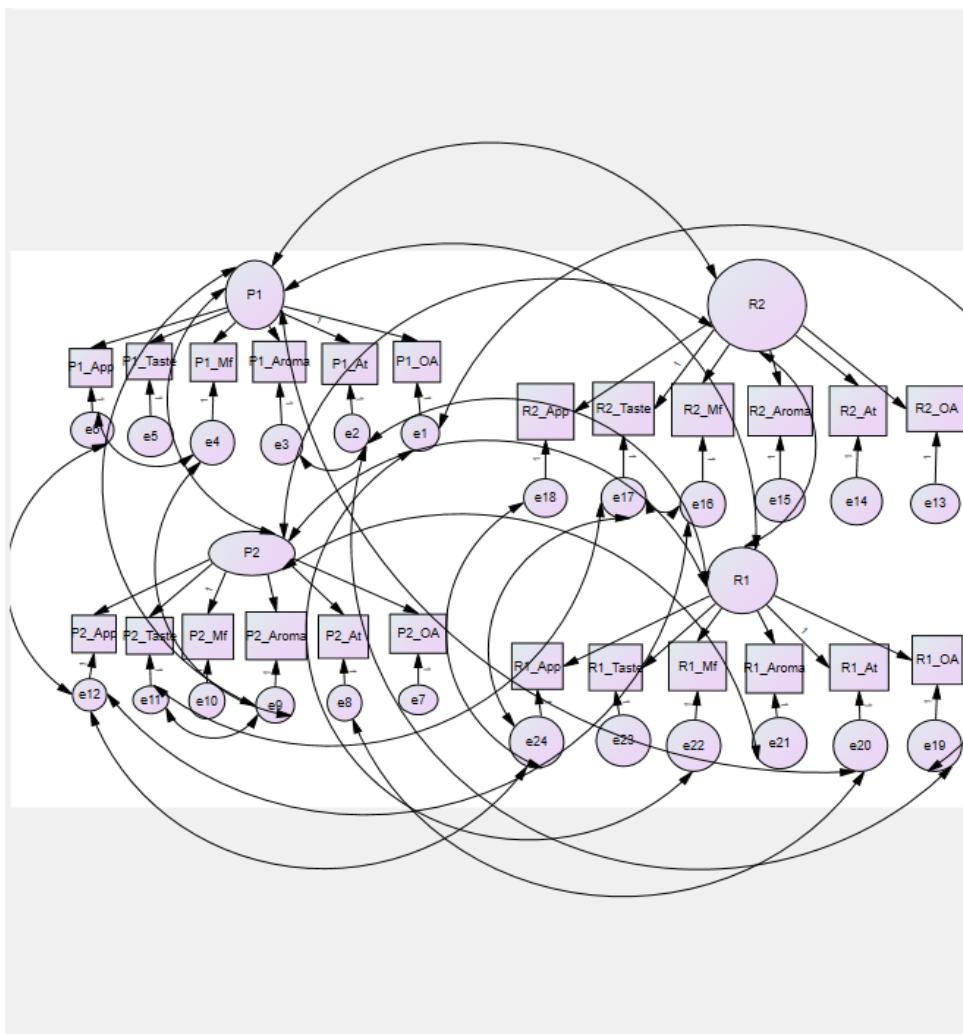


Figure 1 Framework for comparative study of long pepper and black pepper

Table 1 Parameters of Model Evaluation

Sr. No	Parameters Checked	Results
STEP 1 Checking Assumptions		
1	Multivariate Normality(Mahalanobis Distance)	5 Outliers
2	Multivariate Colinearity(Tolerance and VIF)	VIF not greater than 10 Tolerance - Not less than 0.01
3	Linearity (Scatterplot)	Variables have a linear relationship
4	Homoscedasticity(Loess)	Assumptions are not Violated
5	Variance	Not greater than any other variable
6	Sample Size	69
Step 2 - Model Specification (EFA)		
7	Determinant	2.42
8	KMO and Bartlett's Test	.827/261.7
9	Eigenvalue	The factors were restricted to 4
10	Rotated Component Analysis	4 Factors and 24 Variables
11	Reliability Test	Cronbach's Alpha (0.916, 0.863, 0.910, 0.904)
12	Complexity	Df = 1.15
Step 3 - Confirmatory Factor Analysis(CFA)		
13	Unidimensionality	Model Fit Analysed
14	Convergent Validity	Established
15	Discriminant Validity	Established
16	Nomological Validity	Established
Step 4 - Model Testing		
17	Absolute Model Fit	All the values of the model meet the threshold value
18	Incremental Model Fit	All the values of the model meet the threshold value
19	Parsimonius Model Fit	All the values of the model meet the threshold value

Table 2 Final Model Fit Parameters

Final model fit parameters	Expansion of the parameter's title	Thresholds for acceptable fit	Values
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CMIN p-value	Chi-Square value Probability Value Minimum	≤ 0.05 ≤ 5.0	261.715 0.57
CMIN/df	Discrepancy	≤ 0.80	1.15
GFI	Goodness of fit	≥ 0.80	0.8
AGFI	Adjusted goodness of fit	≥ 0.85	0.7
NFI	Normed Fit Index	≥ 0.80	0.8
RFI	Relative Fit Index	≥ 0.80	0.8
TLI	Tucker Lewis Index	≥ 0.80	0.96
CFI	Comparative Fit Index	≥ 0.85	0.97
RMSEA	Root Mean Square Error of Approximate	≤ 0.08	0.47
RMR	Root Mean Square Residual	≤ 0.08	0.08

According to Table 1 & 2 depicts the data analyzed through structural equation model testing to find that the correlation of the factors of - Paneer with black pepper(P1) - medium and positive with Appearance(r value = 0.6, p value = 0.00), Aroma (r value = 0.7, p value = 0.00) Taste (r value = 0.8, p value = 0.00), Mouthfeel (r value = 0.8, p value = 0.00), Aftertaste (r value = 0.9, p value 0.00) Overall Acceptability(r value = 0.9, p value = 0.00) are significant with scope for improvement by adding Long pepper to this sample instead of Black pepper that mellows the flavor which would better the taste and mouthfeel of the samples, Paneer with Long Pepper (P2) - high and positive with Appearance(r-value = 0.6, p-value = 0.00), Aroma (r-value = 0.5, p-value = 0.00), Taste (r-value = 0.9, p-value = 0.00), Mouthfeel (r-value = 0.9, p-value = 0.00), Aftertaste (r-value = 0.9, p-value = 0.00) Overall Acceptability(r-value = 0.9, p-value = 0.00) are significant. The correlation of the samples of - Rasam with black pepper (R1) with Appearance (r-value = 0.5, p-value = 0.00), Aroma (r-value = 0.5, p-value = 0.00) Taste (r-value = 0.8, p-value = 0.00), Mouthfeel (r-value = 0.8, p-value = 0.00), Aftertaste (r-value = 0.8, p-value = 0.00) Overall Acceptability (r-value = 0.8, p-value = 0.00): the correlation is medium, positive and significant with scope for improvement similar to Paneer with black pepper by replacing black pepper with long pepper that mellows flavours that could improve taste, mouthfeel, aroma, and appearance while the correlation of Rasam with Long pepper (R2) having Appearance (r-value = 0.6, p-value = 0.00) Aroma (r-value = 0.7, p-value = 0.00) Taste (r-value = 0.8, p-value = 0.00), Mouthfeel (r-value = 0.8, p-value = 0.00), Aftertaste (r-value = 0.8, p-value 0.00) and Overall Acceptability(r-value = 0.9, p-value = 0.00) are high, positive and significant. Hence, both samples with Long pepper, Paneer, and Rasam are the best samples, in terms of the factors considered.

5. Conclusion

The aim of the study was a comparative analysis of long pepper and black pepper using sampling. The two peppers were used with Paneer Pepper Dry and Pepper Rasam - Paneer with long pepper, Paneer with Black Pepper, and Rasam with long pepper and Rasam with Black pepper respectively. These samples were used on a set of respondents and compared the factors of Appearance, Aroma, Taste, Mouthfeel, Aftertaste, and Overall Acceptability among the samples for Paneer with black Pepper and long pepper, Rasam with black pepper and long pepper for survey data was gathered.

The study of the comparison between long pepper and black pepper regarding how long pepper can be merely used as a traditional spice, which not only is better in taste but is accepted to be better overall when compared to black pepper. Accordingly, the purpose of this study was to ascertain how customers perceive the introduction of an alien exotic spice in terms of their acceptance, preference, and level of receptivity to a spice that is essentially meant to be traditional but has been off the grid due to declining production and a preference for using black pepper over time. The study was done with the help of a structured questionnaire and the data was collected from 69 respondents of Bangalore, Karnataka. (70 responses were collected and only 69 were usable).

A comparison of sample preparations using both spices was used to study the differences between the two spices mentioned. The dishes prepared were paneer fry and rasam, and there were two different samples of each. The control group comprises 'P1' - Paneer sample made with black pepper and 'R1' - rasam made with black pepper. The treatment group comprises 'P2' - Paneer sample prepared with long pepper and 'R2' - Rasam made with Long pepper. Each sample was analysed based on the taste, aftertaste, aroma, mouthfeel, appearance and overall acceptability.

The correlation of control group 'P1', of the component's Taste, aftertaste, mouthfeel and overall acceptability are high, positive and significant and the appearance and aroma are medium, positive and significant and have scope for improvement.

The correlation of control group 'R1' - of the components Taste, aftertaste, mouthfeel, and overall acceptability are high, positive and significant while appearance and aroma are medium, positive and significant and have scope for improvement.

The correlation of treatment group 'P2' of the components - Taste, aftertaste, mouthfeel and overall acceptability are high, positive and significant while appearance and aroma are medium, positive and significant and have scope for improvement.

The correlation of treatment group 'R2' - of the components - Taste, aftertaste, overall acceptability and mouthfeel are high, positive and significant, and appearance and aroma are medium, positive and significant and has scope for improvement.

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