

Analytics for the comparison of Mughlai and Awadhi cuisine network graphs to visualize the usage of ingredients in cuisine groups

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Indian cuisines are known for its exquisite delicacy and there are over 5000 such traditional preparations practiced in the country. Some of these cuisines are identified with cuisine families such as Mughlai, Awadhi, Udupi, Chettinad, Hyderabadi, Punjabi and so on. These cuisine groups might have emerged owing to various historical and geographical factors viz., food availability, climatic conditions, cooking traditions and cultural choices over a period. However, the divergence or convergence among the selected cuisine families other than referring to the attributes in the subjective manner, are rarely studied. This study focuses on data mining coupled with visual analytic methods for comparison of Mughlai and Awadhi cuisines.

Keywords: Awadhi, Cuisine ingredients, Mughlai, Traditional foods, Shared cuisines

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India as a country has been invaded and occupied by other cultures for a long time and each has left its own mark on food habits of the local population. It is reported that around 5000 traditional preparations were practiced in the country throughout the ancient Indian civilization¹. Each of the states or regions has its own unique food delicacies as well. Sometimes these are also shared among other cuisine groups due to geographical or cultural proximities².

Mughlai cuisine is one of the richest cuisine families in the country³ with distinctive non-vegetarian preparations. Some of these cuisines have travelled to other regions as a few variations are found with Kashmiri and Hyderabadi cuisines. Mughlai delicacies are prepared with exotic spices, dried fruit, nuts, milk, and cream making it the royal rich and spicy meal. Mughlai cuisine comprises dishes of kebabs, kofta (meatballs), nihari, pulao, and biryani. Paneer is also used for preparing vegetarian dishes to suit vegetarian dietary requirements⁴. Mughlai cooked

dishes of safiyana, meat and rice cooked together, meat cooked with ghee, spices, curd, eggs, etc. are described in the Ain-i-Akbari⁵.

Awadhi region located in Lucknow was one of the 12 subas of the Mughal Emperor⁶, Akbar. Awadhi cuisines have also adopted some of the steps used in the preparations of Mughlai cuisines. These preparations include kebabs, kormas, keema, salan, lamb, pasinda, biryani, kaliya, fresh cake mix, pulao and so on. In Awadhi cooking styles, marinating fish, vegetables with curd and spices contribute to its unique taste and aroma. Awadhi cuisines may be less popular compared to Mughlai. Some of the quality attributes of Mughlai and Awadhi are given in Table 1.

Data analysis tools

Visual analytics is the science of analytical reasoning supported by interactive visual interface. These methods allow decision makers to combine their flexibility, creativity and background knowledge with storage and processing capacities of today's computers to gain insight into complex problems¹¹. As the information is represented visually, it can help

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Table 1 — Mughlai Vs Awadhi

Mughlai Cuisines	Awadhi Cuisines
<ul style="list-style-type: none"> • Most of the Kebabs of Mughlai region are cooked on Tandoori⁷ • Mughlai cuisines were strongly influenced by Persian and Turkish cuisines of Central Asia⁷ • Dastarkhwan, a ceremonial tradition of laying food on the table was adopted⁷ • Other than Dum Pukht, it has peculiar cooking styles like Baghar, Dhuandhar and Dum⁷ • Mughlai cuisines are famous for the exotic use of spices, dried fruits and nuts⁸ 	<ul style="list-style-type: none"> • Awadhi tradition of cooking is Dum Pukht style described as maturing of prepared dish⁹ • Speciality Kebabs of Awadhi region are cooked on large flat brass pans called mahi tawa¹⁰ • Awadhi preparations are less spicy with smoother textures, multiple straining and attention towards color and aromatics¹⁰ • Awadhi cuisines are simple adaptation of Mughal cuisines to local customs and practices¹⁰ • Dastarkhwan is customary in Awadhi¹⁰

decision makers or researchers to interact with the results directly helping them to gain better reasoning and there by arrive at robust decisions. Further, data mining tools are used for automated data analysis coupled with visual representations¹².

Data mining is a process of analyzing data on the identified attributes, summarizing it into useful information and discovering the non-trivial, previously unknown patterns, models and graphs¹³. There are specialized tools for looking into relationships between the categorical variables¹⁴. Web node is one of the graphical representations that is used to illustrate the strength of the relationship between values of two or more symbolic fields. The graph uses lines of varied thickness to indicate connection strength, which maps the association between two categories. The software, Clementine¹⁵ was used to generate the web node that draws the lines between categorical variables¹⁵.

Methodology

Two of the prominent cuisine groups, Mughlai and Awadhi were selected out of 34 cuisine groups identified from the database. To say a few, they include Kashmiri Pandit, Kashmiri Wazwaan, Udupi, Chhattisgarh, Mughlai, Garhwal, Bohra, Malabar, Malwa, Sindhi, Mizo, Chettinad, Hyderabad, Konkan, Kongunadu, Awadhi and so on¹⁶.

The graph is generated by the software using the database comprising of ingredients and its association with a particular cuisine family. It reflects strength of the relationship between an ingredient usage and a specific cuisine family in terms of the edge thickness. More the thickness, stronger the relationship with

a specific cuisine. So, it can used to infer the importance of a particular ingredient to a cuisine family.

The Web node graphs were generated on shared cuisines, shared ingredients and on the usage of spices in both Awadhi and Mughlai cuisines. The graph depicts shared origin between Mughlai and Awadhi. The network layout of web node shows the usage of major ingredients which are shared among cuisines of both groups. The circle layout of the Web node graph shows the usage of spice ingredients which are shared along with individual cuisine sets. The Web node graphs as a visual analytic were used for drawing vital inferences between any of the selected cuisine groups in order to understand the food culture and its adaptability with respect to various regions in the country. These graphs use line of various widths indicating a connection strength, which maps association between two categories.

Results

The shared nature of the Mughlai and Awadhi were analyzed in Figure 1. The unique cuisines identified with Mughlai origin were 51, compared to 39 in the case of Awadhi cuisine. A total of 36 cuisines are shared between each other showing the influence of one cuisine family over the other. Awadhi cuisines viz., kebabs and biryanis are known for the Dum Pukht cooking style but Mughlai cuisine has more of grilling and roasting involved in its cooking process. The essence of gravies is ghee, curd and cream with reduced use of tomatoes; fried onions were blended to paste and used in gravies like kormas and nahari. Preparations of rice, bread, chicken, mutton are very popular.

Network layout group with links were used to highlight stronger bonding using spatial differentiation as well as weighted lines¹⁷. Both cuisine families were represented in the graph including the shared cuisines between them (Fig. 1).

The graph illustrates culinary entities, both individual cuisines and cuisine families, using nodes, while connections between a particular cuisine and its cuisine family are depicted as either thin or thick lines. Thick lines indicate shared cuisines among cuisine families, while thin lines represent unique cuisines. For instance, Mughal cuisine stands out, with approximately 60% of its dishes being distinctive to itself, whereas slightly more than half of the Awadhi cuisine is composed of unique dishes.

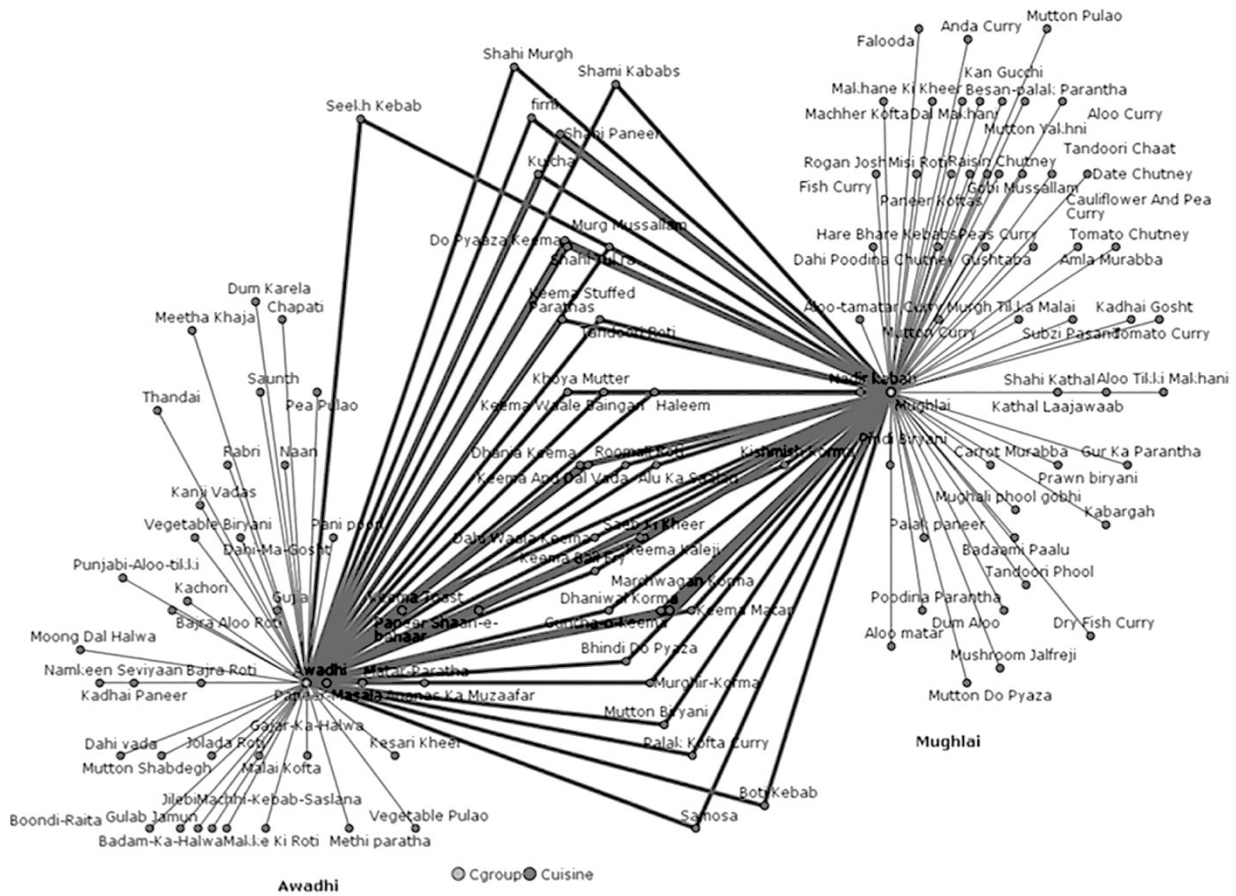


Fig. 1 — Shared cuisines between Awadhi and Mughlai

Similarly, 41% of Mughlai cuisines and 48% of Awadhi cuisines are shared between the two.

In the graph, cuisine ingredients and the cuisine families are shown as nodes. The edges show their association of an ingredient with a specific cuisine family. The ingredient might be either unique or shared as showed in the Figure 2. In the case of shared ingredients, the thickness of the edges are categorized as weak, normal and strong based on the frequency of their usage in various cuisines with respect to a specific cuisine family. In the graph the frequency less than 3 in number is considered as weak, 3-8 is considered as normal and beyond 8 is taken as strong. So in the case of shared ingredients also, there are extensive preparations with either one of the cuisine family. Accordingly, Mughlai cuisines have larger number of chicken based preparations, whereas the reverse is true in the case of muttons.

The ingredients along with their associations with respective cuisine families are showed in the graph (Fig. 2). Also out of 80 major ingredients used in cuisines, 21 belong exclusively to Mughlai and 20

under Awadhi. The number of shared major ingredients is 39. The usage of potatoes, mutton with Mughlai is comparatively stronger than Awadhi whereas maida, basmati rice, cow-milk and carrot are predominant in the Awadhi preparations. Maize, minced beef, Dates are seen unique with the Mughlai preparations.

Mughal cuisine is known for its lavish use of spices, often accompanied by generous amounts of cream and milk. Among the key spices featured in Awadhi cuisine are black and green cardamom, cinnamon, black peppercorns, cumin, bay leaf, nutmeg, and cloves, to name a few. The circular diagram presented in Figure 3 illustrates the utilization of these spice ingredients in both Awadhi and Mughlai culinary traditions, both exclusively and in shared contexts.

In this representation, the connections between a spice ingredient node and specific cuisine family nodes, or the shared category, indicate the frequency of use of a particular spice in various culinary preparations. The thickness of these connections signifies the strength of presence—ranging from weak

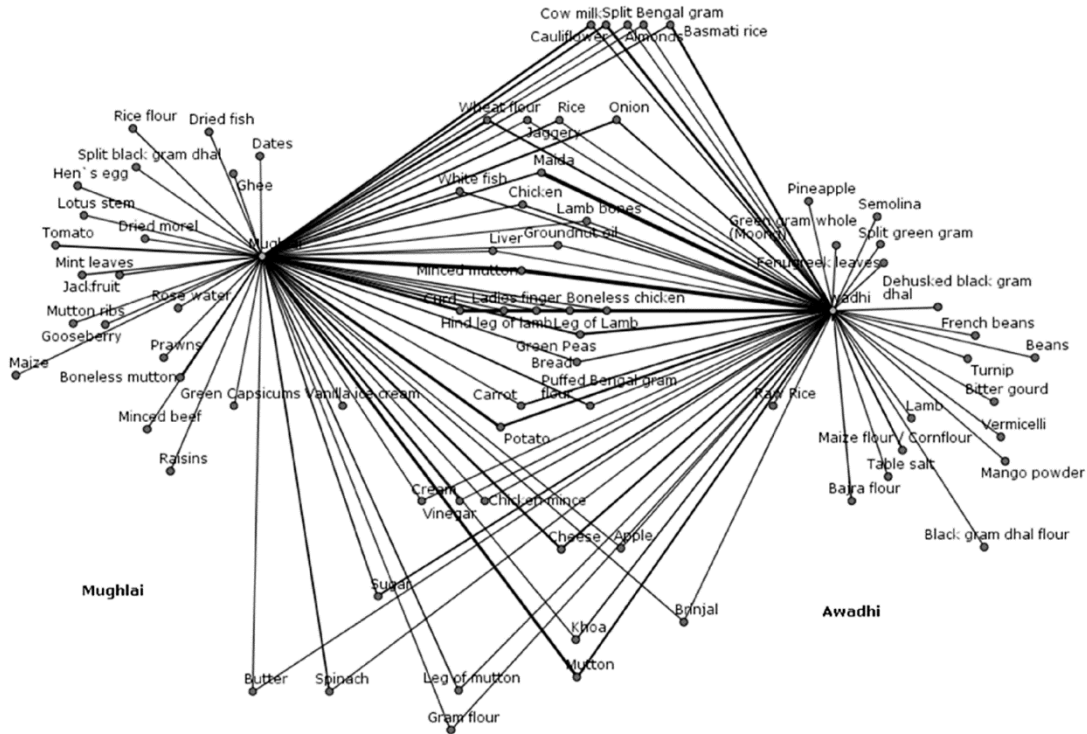


Fig. 2 — Mapping of ingredients between Mughlai and Awadhi

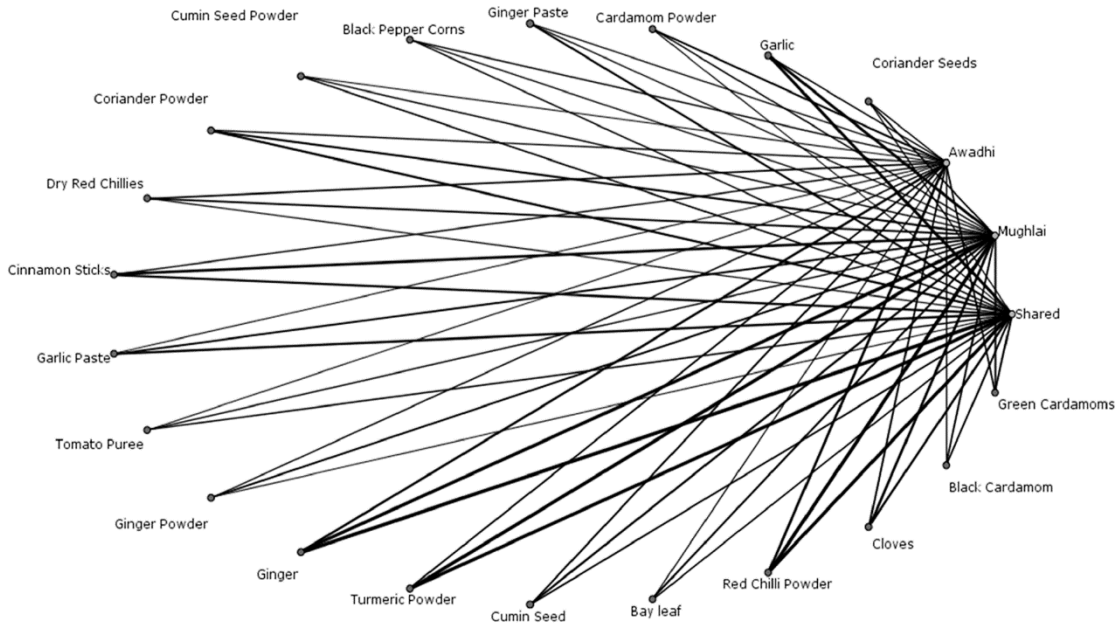


Fig. 3 — Associations of ingredients with Mughlai, Awadhi and shared cuisines

to normal or stronger—in different categories. Spices appearing in fewer than three cuisines are considered to have a weak presence, while those found in three to five cuisines are considered to have a normal presence. Those featured in more than eight cuisines are regarded as having a strong presence.

Important spices such as red chili powder, cinnamon, cardamom, cloves, black pepper, and coriander seeds are commonly used as flavouring agents in both Mughlai and Awadhi cuisines. However, ginger, turmeric, and garlic exhibit greater prominence in shared preparations compared to exclusive ones

found in Mughlai and Awadhi cuisines. Consequently, cloves are more prevalent in Mughlai preparations, while cardamom powder is a favoured spice frequently encountered in Awadhi dishes.

Conclusion

Web node graphs and data mining tools have proven to be invaluable resources for visually representing the intricate relationships between various regional cuisines and their shared attributes¹⁸. Through this approach, we gain valuable insights into the relative preferences for specific ingredients within different culinary traditions, allowing us to readily identify unique and characteristic elements. The visual representation highlights the overlapping between Awadhi and Mughlai cuisines, indicating a strong cultural proximity in terms of food habits between the inhabitants of these regions. Notably, our analysis reveals that while both cuisines utilize a range of spices, the dominance of spice flavours is such more pronounced in Mughlai preparations, as evidenced by the robust connections in the network. This observation suggests that the shared cuisines might lean more towards Mughlai in terms of spice profiles, underscoring the dynamic nature of culinary influences. It's worth noting that while both unique and shared ingredients exist in these culinary traditions, the prevalence of shared ingredients is also important.

This study underscores the potential of exploring and assessing multiple regional cuisine families, delving into both unique and shared attributes. By leveraging visual analytics, and utilizing the emerging artificial intelligence tools and algorithms, we can catalyze innovation in the field of culinary science. This innovation is not only pivotal for enhancing the nutritional and functional aspects of traditional Indian foods but also for protecting our cultural heritage eternally.

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Conflict of Interest

The authors declare that they have no conflict of interest with any agencies/stakeholder in publishing the manuscript.

Author Contributions

MV, KSS & SB, all worked on the database and the preparation of analytics. TP carried out the content editing and literature study. SCS contributed towards the content editing and analytics preparation. MP conceived the idea, outlined the methodologies, and finalised the manuscript.

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