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10 November 2015

Online at <https://mpra.ub.uni-muenchen.de/68385/>
MPRA Paper No. 68385, posted 16 Dec 2015 15:55 UTC

A Portrait of Diversity In Indonesian Traditional Cuisine

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Abstract

The archipelagic geography and demography of Indonesian people due to the way people serve food and drinks on the table is analyzed. Statistically some properties about the food recipes are observed, while the analysis is followed by the methodology to see the clustering of the food and beverage due to their ingredients. The global mapping of all the food yields four classes of the food that is related to the way people conventionally prepare the cuisines, whether the recipes are on vegetables, fish and seafood, chicken and poultry, and meats. It is obvious that ingredient wise, the diversity of the food is emerged from traditional ways adding spices and herbs. For more insights, the analysis for food dressings and traditional drinks are also delivered. While the mappings exhibit the classes of food and beverages based on the purposes and styles of the service in the cuisines, some signatures of regional localities are also detected.

Keywords: food, culinary, diversities, clustered map, memetics, phylomemetic tree, hierarchical clustered tree.

1. Introduction

The way people prepare their daily cuisines are probably one of the most important direct interaction between things related to culture and nature [14]. Half of the issue about food is about culture and the other half is about, environment and about maintaining life. The diversity of food with all the respective ingredients is culturally diverse all over the world. The history of how people consume food is rooted culturally and biologically [15].

Socially, food has also played a major role. Many analyses have drawn relation of food with those of social life as formed by habit, traditions, causal daily life [6]. Social interaction may change the way people preparing meals and drinks, from the processes of cultural assimilations, to the economic processes due to industrial and global life [1]. Every community has their own unique way to serve their meal, and it may give signature of the way people living specifically. Mapping the traditional food can reflect the landscape of the ethnography [24].

The similar course can be seen in Indonesian archipelago. The diverse ethnic groups in Indonesia also exhibits the large variations of cuisines across the country. Indonesia is located in the tropical zone of earth where ethnic groups are spreading within thousands of islands. The tropical climates have given access to various herbs and spices that have been used as ingredients for food and drinks [5]. Thus, the variations of food and drinks across the archipelago are also related to the different kinds of spice plants there are locally. Studying the diversity of food potentially brings us to more insights on anthropological understanding of the social complexity [23].

Today, the traditional foods and drinks are even further for the industrial and consumer exploitations. Traditional cuisines are now even delivered as processed food by the industry [12]. Exoticism of traditional foods, be it related to the unique taste and also its promise for the savor and healthy merits [3]. Even further, the industrializations of the traditional foods and drinks have become a kind of diplomacy based on the values and virtues of food, named as “gastro-diplomacy” by some asian countries with campaigns include the mysticism, exoticism, naturalness, and healthiness of the food [25].

The paper reports the studies on thousands of traditional food and drinks recipes throughout the countries in order to have a visual mapping of the diverse ethnography in Indonesia due to the diversity of their respective unique cuisines. The initiatives to collect the data of Indonesian cultural heritages via online in <http://www.budaya-indonesia.org/> have revealed more thousands of data from traditional culinary receipts from all over the country on line [20]. This has delivered opportunity to analyze the data of Indonesian traditional food of the existing diversities [21].

2. Meme in the tip of the Tongue

The study of the food and beverages diversity in the archipelago has directly or indirectly relation to the diversity of ethnic groups and communities within. By looking cuisines in this way, the study of traditional food in Indonesia should not be seen exclusively separated with the meanings of them to the actual life of the people. Food and beverages are not merely about consumption but many aspects in which they are prepared [8]. Traditionally, particular food and beverages have implicit meanings, related to the health maintaining, prevent disease, and behaviors during times of food scarcity and abundance [10].

On the other hand, when it comes to the local and ethnic way of living, food and beverages have become a sort of social identity within people [cf. 9]. In Indonesia, it is common to name some sort of food with the places or ethnic groups from which it is originated, e.g.: “*Sate Padang*” (satay from Western Sumatera), “*Tahu Sumedang*” (fried tofu from West Java). Each ethnic group has unique

mixtures of ingredients on served food. Even further, the cooking recipes are passed from generation to generation and becoming the part of collective knowledge of local people [cf. 13]. Food and beverages in traditional culture have been an integrated element of culture and can be seen as a reflection of a sort of “art of living” [17]. Thus, food and beverages can be linked to the collective knowledge and memories among people in communities, be it ethnographic or geographic wise. The recipes of ingredients mix are information passes by generations as cultural heritage.

Collective information passes from generation to generation has been evolved in many ways into the kinds of foods and beverages as delivered to day within the ethnic social group and the society in the Indonesian archipelago. What people perceive as taste of the good food is actually an emerged properties of the mixtures of ingredients and various materials expressed in recipes. By having the hypotheses that the emerging tastes of food are coming from the mix and combination of the ingredients, every food can be written as the representation of the elements used making it.

Say B is the finite set of all possible elements of food from which food and beverages can be served, and $b_i \in B$ is a particular i -th element from all possible l_B food elements. Thus a specific food $m \in M$ is the binary set of “1” and “0” denoting whether or not the element b_i is used as ingredient in preparing it. Consequently, the length of all food representation in our library is l_B , where,

$$m_{b_i} = \begin{cases} 1, & \text{the } b_i \text{ is used in food } m \\ 0, & \text{otherwise} \end{cases} \quad (1)$$

which can now be simply represented as,

$$m = \cup_i b_i \quad (2)$$

The smallest unit of information on every particular food and beverages, in its relation to the equivalent biological counterpart, meme [19], is denoted by vector m . Thus we see each food as emerged by the complexities of the mixing compounds; a representation that called “memeplexes”. Here, we have the memeplex matrix in the size of $l \times N$, where N denotes the number of food and beverages we put into our account for analysis of the diversity.

From the table of the memeplex we can now construct the distance matrix among the cultural objects. In this step, we can do comparison between two memeplexes that directly yields the Hamming distance between two artifacts or do the alignment algorithm. For memeplex with constituted by binary strings, the hamming distance can be measured as the numbers of different bits,

$$\delta_{hamming} = \|m_1 XOR m_2\| \quad (3)$$

The greater $\delta_{hamming}$, the more two memeplexes are different and the less it is the more similar the two are. The obtained distance matrix can be used to build the similarity tree, called as “phylomemetic tree” as in phylogenetic tree in biological counterpart [22], by using the dendrogram or cladistics techniques. A useful algorithm that can be used to have clearer view of the clustered artifacts is the so-called UPGMA (Unweighted Pair Group Method with Arithmetic mean). This is a popular bottom-up data clustering method used in genetics.

In this tree construction technique, one assumes the constant evolutionary changes. In short, the algorithm examines the structure present in a pairwise distance matrix to construct the dendrogram aftermath. Then at each step, the nearest 2 clusters are combined into a higher-level cluster. The distance between any of clusters A and B is taken to be the average of all distances between pairs of objects "a" in A and "b" in B. By using this method, we can examine whether our visualization has conform with some analytical observation in general.

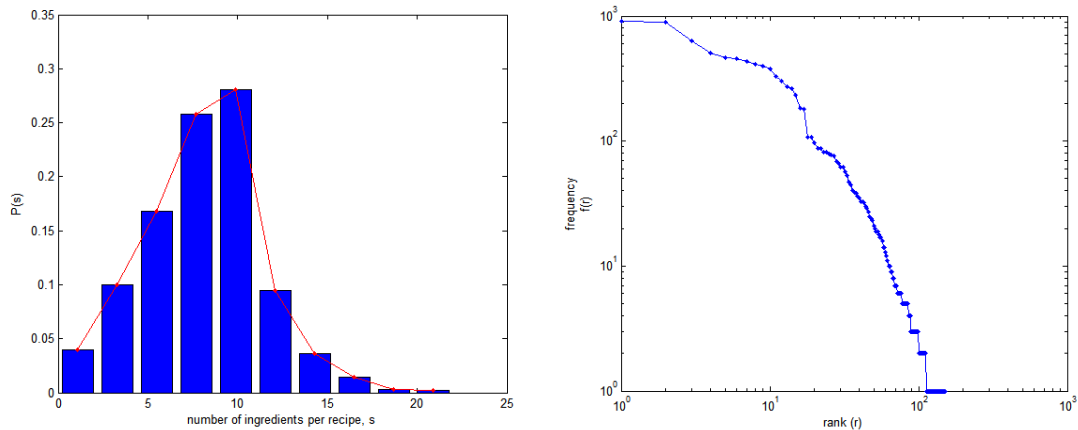


Figure 1. The distribution of recipe size showing the probability of food elements per recipe used in the analysis (*left*) and the frequency rank plot of the ingredients within Indonesian food.

A visualization of phylomemetic is aimed to see the rooted commonality among cultural objects in their features. Phylomemetic tree shows the diagrammatic view of the similarities embedded in the features of cultural artifacts while focusing in their differences. This is the very interesting features of the phylomemetic diagram and become the theme want to be discussed deeper in the paper. We will not discuss about the terms in the memetics but yet focusing on what we can study by understanding meme as the smallest information unit in human mind as the source of their productivity making cultural objects, be it songs, paintings, architectural designs, etc. Here, the notion of memetics laid upon the realization that meme can be detected in the artifacts and cultural objects. It is not laid in the artifacts, but one can observe meme by scrutinizing the artifacts [19].

3. Phylomemetics of Indonesian Food

The statistics of the food recipes in the repository data shows that the number of ingredients are bounded in their distribution within all list of cuisines [cf. 2]. Most of the food have ten ingredients, and the recipes with very large or very small amount of ingredients are not likely. However, as shown in figure 2a, the distribution is skewed to the left. This means that more food is served with smaller number of ingredients rather than with more. Some food like *Nasi Boranan* from Lamongan (East Java), *Dalca Daging* from Aceh, and Spicy Porridge in Central Kalimantan employ more than twenty kinds of ingredients, followed with those Eggplant Chicken Curry from South Sumatera, the Beef '*Gulai*' from Western Sumatera.

By contrast, some ingredients are used the most in many food. Some ingredients varies over three orders of magnitude in Indonesian cuisines relative to the rarest one (figure 2b). The use of onion, garlic, chili, lime, ginger, pepper, coconut and turmeric is most likely among those more than half of Indonesian recipes. Some unique ingredients are also found, especially due to the use of some unique plants as herbs and spices. For instance, some ferns are used as ingredients, like the food *Jangan Pakis Banyuwangi* (East Java) or the *Tumis Kelakai* (Central Kalimantan). Some unique cuisines like *Gulai Telur Tapak Liman* from West Sumatera uses the elephantopus scraber leaves in its recipes. Those and the other unique ingredients, for instance, turkey berry in food like the one *Tauco Encer* from North Sumatera, can actually be related with the specifics of the diverse plants in the tropical forest in the archipelago.

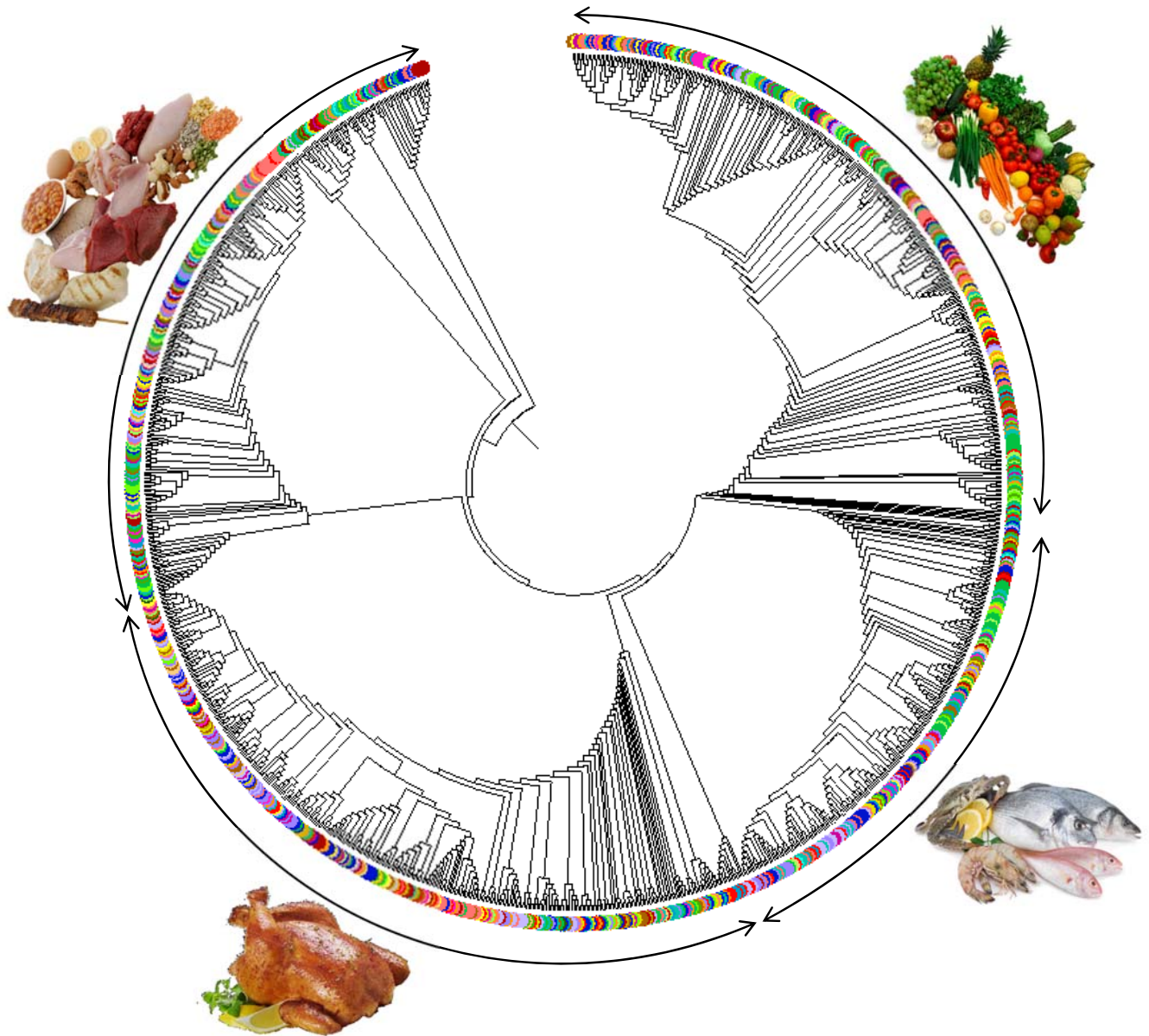


Figure 2. The mapping of Indonesian dishes over the archipelago within the courses of fruit and vegetables, fishes and sea food, processed chicken, and meat (*clockwise*). The different colors of the nodes are the different social ethnic groups and geography within the archipelago: from dark green to dark red is from the west to eastern Indonesia.

From the distance matrix we gathered from the calculation as in eq. 3, we would like to see the clustering of the food within the archipelago as reflected in our dataset. By starting with grouping two taxa whose smallest distance, one by one we add the node in the midpoint of the both, and the first twos are put on the tree. The distance from the new node to the others will be the arithmetic average as in the standard phylogeny UPGMA model. By reiterating the mechanism, the last taxon becomes the root of the tree [18]. Thus, for any two clusters M_i and M_j , the distance of the two is,

$$d_{ij} = \frac{1}{[M_i][M_j]} \sum_{m_i \in M_i, m_j \in M_j} \delta_{hamming}(m_i, m_j) \quad (4)$$

Where $[M_i]$ and $[M_j]$ both denote the number of sequences in cluster i and j respectively. This calculation delivers us to the clustering hierarchical tree as shown in figure 2. It is interesting to see the clustering of the food as shown in the figure and discover that there are at least four groups of food exhibited there.

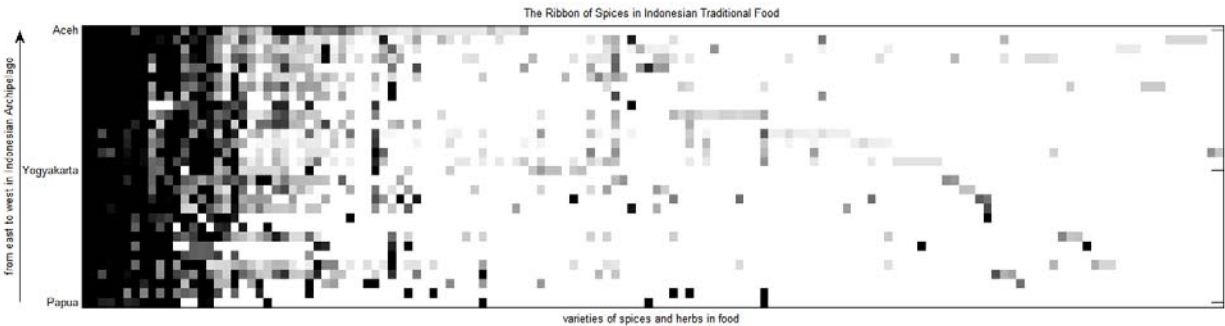


Figure 3. The colormap distribution spices and herbs additions in Indonesian tradition food (*vertical axis in provincial-based*) from the most common ingredients to the more unique ones (*horizontal axis from left to right*). The one with darker color is the one with greater proportion in the recipes within the province.

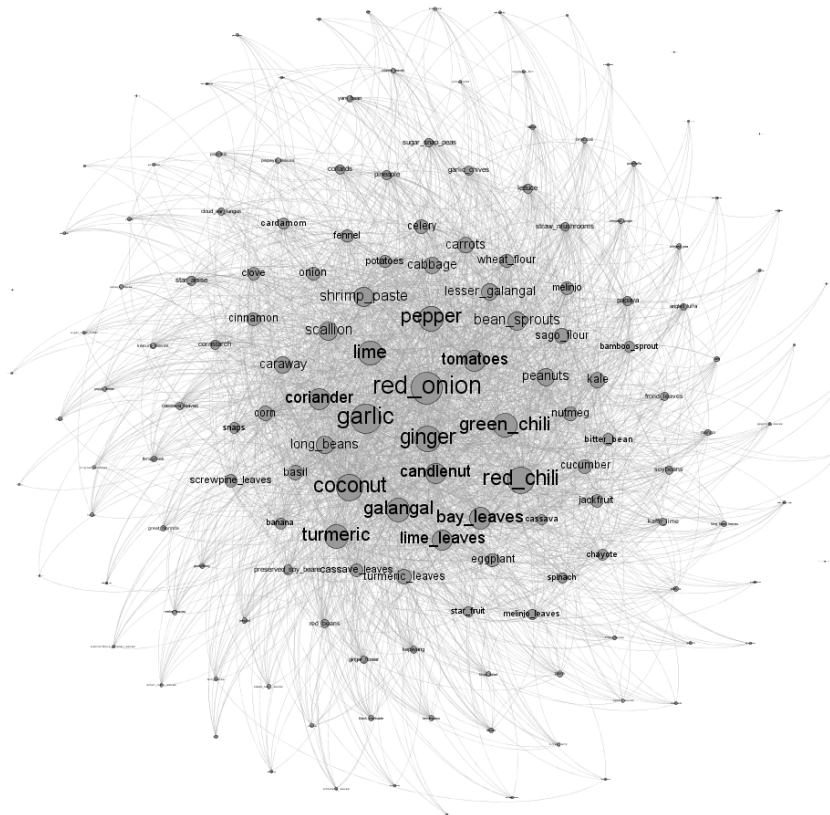


Figure 4. The network of plants of spices and herbs acquisition in Indonesian food. The bigger the nodes, the larger portions of usages in more food recipes.

The four groups fit the classifications of food by the main ingredients and the way to serve the food on the table. The first group is categorized as the food from vegetables and fruit plants, the second is the fish-related food, the third is the food from chicken and poultry related, and then followed by the meat related one. The four groups can actually be related with how most people in Indonesia deliver their daily meal conventionally [16]. In the complete regular daily main course of Indonesians, along with the boiled rice, there should be places for vegetables, fishes, and meats. The last three is mostly accompanied with various dressings or sauce, called “sambal”, a mixture of herbs and spice. All of the food is placed on the table for people take some portion of the food into their own plates. A style of serving food that also have become a cuisine introduced by the Dutch, *rijsttaffel* (english: rice table), where every available food is placed on table [5].

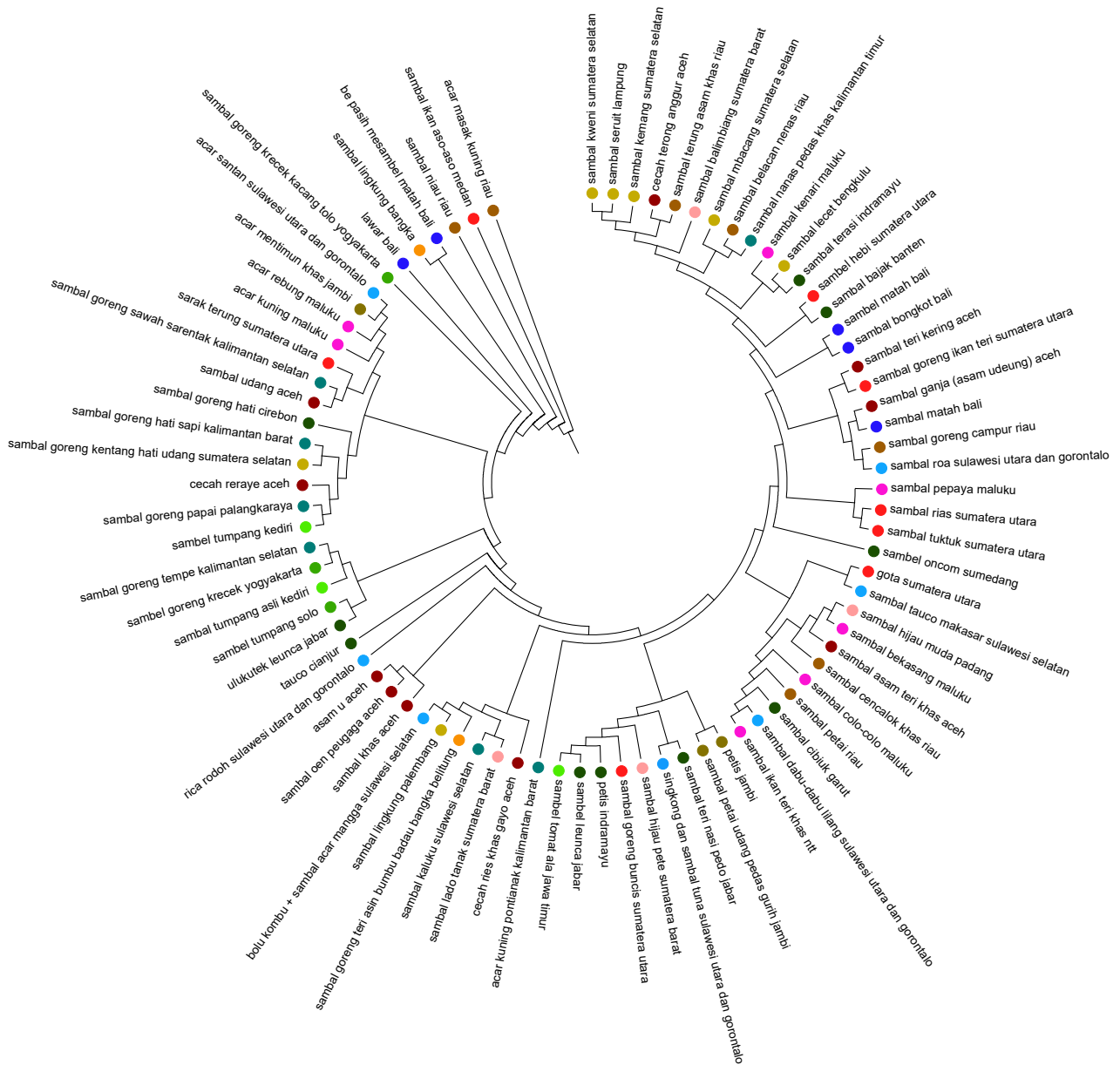


Figure 5. The mapping of Indonesian traditional food dressings.

However, the four groups came forward as emerged by the different types of ingredients used to serve the food on the four classes, vegetables, fishes, and meat. Within every class, we could visually see some sort of gradation from the western (dark green) to the eastern (dark red) of Indonesian archipelago. Even though it is not precisely robust, it shows some gradual changings among neighboring ethnic people on the making of recipes of the traditional food. There are similarities on the taste for food flavor due to the favorite use of ingredients in serving cuisines among closely related people, be it as neighboring ethnic groups, anthropological affinity, or merely just demographical or geographical closeness.

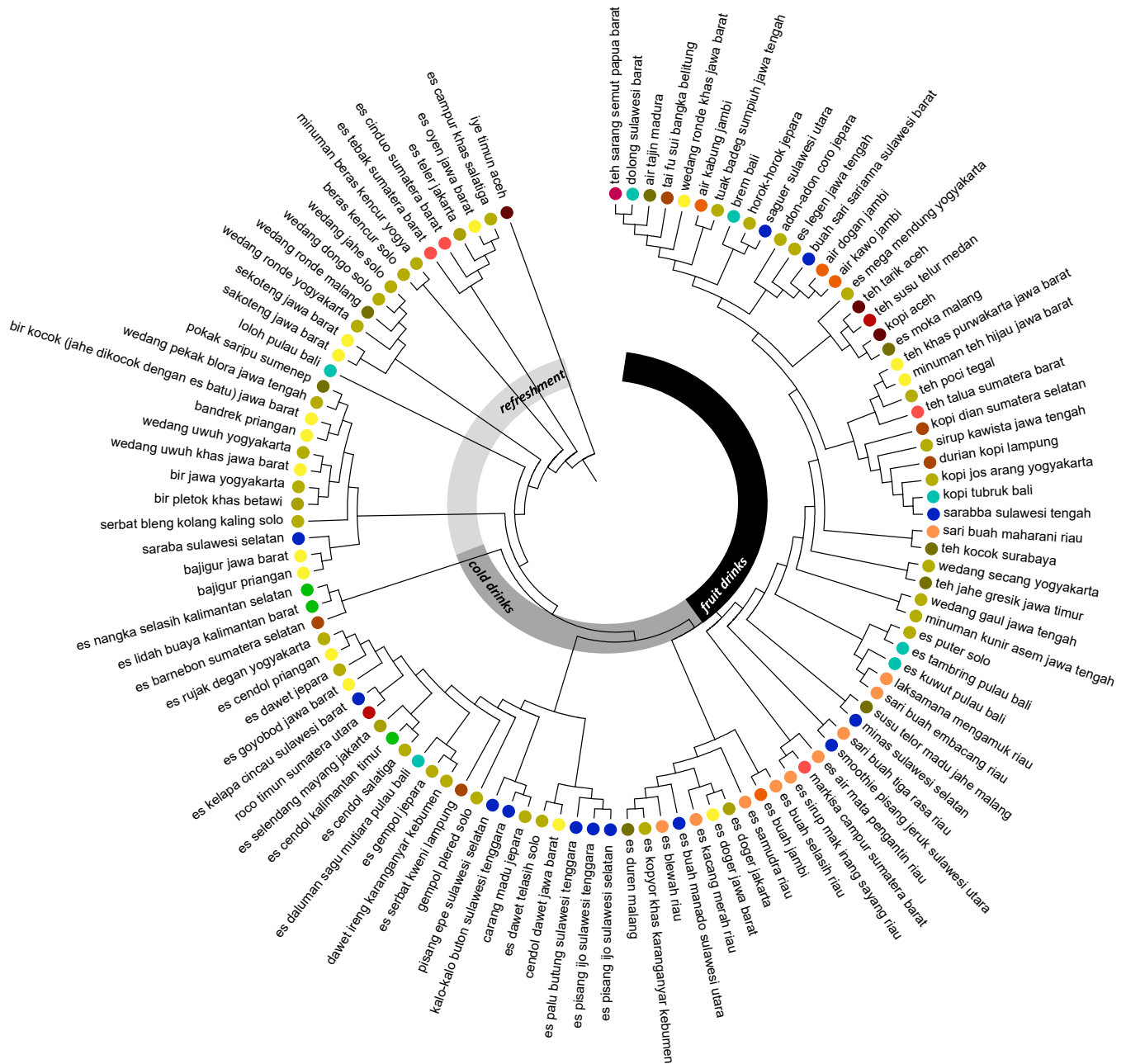


Figure 6. The mapping of Indonesian traditional beverages and drinks: from the type of fruit-related, served cold, and refreshment beverages.

4. Spicy foods and drinks from Indonesia

The tropical climate of Indonesian archipelago have made it possible for traditional people harvesting the spices and herbs from many sources of plantations, be it from the agricultural processes or simply by collecting in the woods. The varieties of the plantations on different soil islands have made different ways to prepare and serving the food. Historically the Indonesian spices have played important roles in the chronological narratives shaping the nations in the country until today [4].

The interaction of Indonesian people with those from the west have been related to the stories of the western going out to the sea for the sake of spice trade [7]. The existence of spices and aromatics, like cloves, nutmeg, mace, sandalwood, and all have become the great attraction to motivate Europeans sailing to the unknown ocean in Asia. It has been called as the “spice route” for spices are indeed needed for many aspects consumption, in fact not only food [11]. Thus, mapping out Indonesian people passing the recipes from generations to generations in their localities based on ethnography and archipelagic demography might give us insights on the evolving societies.

Within Indonesian food, the percentage of the herb used in the food in the places by transforming the matrix of the recipes into the 33 provincial categories is shown in figure 3. It is obvious that there are many ingredients commonly used in one place but unused in the other places. The way people use herbs and spices in their specific recipes is however differ from place to place. As it has also depicted statistically in figure 1b, most of the ingredients are quite rare to be used in the most recipes. Some spices are used in only few recipes due to the commonality of the ingredients ecologically available in which the food is served. From west to east side of the archipelago, apparently the more some unique ingredients are used that are not specifically used in the western side. The vast geographical landscape from west to east depict the varieties of herbs and spices uses within food. Apparently this is due to the unique availability of the ingredients at those particular places. The figure somehow may also depict the different richness of places from the west to eastern side of the country due to herbs and spices uses as ingredients within traditional food.

Moreover, traditional recipes have their own unique ways of mixture combinations and portions when they are added to make the food. When two (or more) spices are added to the same recipes, they can be said to be related or connected altogether. From this perspective, we can represent the ingredients network as they added to traditional recipes as shown in figure 4. The spice network shows the relation among the ingredients in the database of Indonesian traditional cuisines. On the other hand, the network figure also shows the most common spices are used in all of the traditional recipes. The bigger the node is drawn, the more its fraction of usage in the traditional recipes. The ingredients of food within geographical, as well as etno-graphical social places can be made for richer analysis.

In order to see more clearly, we do the exact same methodology for the phylomemetic tree into hundreds of special mixtures in dressing recipes. Culinary dressings are an element of the cuisines of which the main ingredients are the mixtures of spices, yet emerging most about the overall food flavor. As shown in figure 5, the majority of the data is from outer Java Island, the most populated island in the country. It is shown that dressings from Java Island (marked with greener nodes in the figure) is more clustered one another relative to the ones from the outer Java Island. On the other hand, the clustering is exhibited among those western to eastern side of Sumatera (nodes with gradual red colors). The dressings from the eastern side of the country tends to spread all over the tree mapping.

In order to complete our observation and mapping, we also deliver the mapping for the drinks and beverages from all over communities and ethnic society in the archipelago. The similar method is done and shown in figure 6. Interestingly, the tree is showing another tree of taste as alternative to the previous mapping on food and the food dressing. Apparently, the tree emerges three leaves of the

tree representing the major categories of the drinks, clockwise rotation is the fruit (juice)-related drink, served-cold drinks, and the refreshment beverages. In each category of the drinks are the clustered region of the drinks. On spice-related ingredients, we can see that some of the drinks are also added with spices, especially those within the refreshment class.

5. Concluding Remarks

The foods and beverages are mapped into the phylomemetic hierarchical clustered tree as a portrait of the diversity of social and ethnic groups in Indonesia. The recipes are gathered from online public participatory and analyzed statistically to obtain some macro properties of the existing food and beverages from the people across the archipelago. The matrix of recipes are then transformed into the distance matrix, and by applying the clustered analysis, the phylomemetic tree of Indonesian foods and beverages are thus constructed.

The mapping has come to some interesting insights are exhibited. The use of spices and herbs in Indonesian food has become the marking point distinguishing food from places to places in Indonesia. There is strong relations between the way people serving the cuisines and the existing and available ingredients in their locality. The foods are clustered over the phylomemetic tree for the variations of ingredients included in them, especially the spices and the local availability and customs of the society. The similar analysis has been delivered for the traditional food dressings and beverages. The results are a mapping of clustered food, dressings, and the drinks over the archipelago. While the mappings exhibit the classes of food and beverages based on the purposes and styles of the service in the cuisines, some signatures of regional localities are also detected.

Acknowledgement

Ms. Iklimah and Ms. Endah Kinarya Palupi (students from Universitas Islam Negeri Sunan Gunung Jati, Bandung) are worth the gratitude for technical assistance. We thank Sobat Budaya Indonesia for data mining, and the Surya University for support in which period the research is delivered.

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