A Journey Back in ~~Time~~Taste: Herbs and Spices in Medieval German Cuisine

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Abstract: In the Middle Ages food and drink are believed to be primary sources for maintaining health. Cooking recipes do reflect this theory, and herbs and spices are potent means to alter the humoral status of foodstuff. Unfortunately, we know very little about the impact humoral rules had on the flavour of food, respectively about the flavour of food in general. Based on data produced in a project digitizing, semantically annotating, and researching medieval German, French, and Latin cooking recipes, we want to investigate this aspect. Our focus is to generate flavour profiles for ingredients, dishes, humours, recipe collections, and so on. We question if the results of this experimental analysis can provide a new method to compare cooking recipes and recipe collections, etc., and what the insights might be.

The kitchen of the Middle Ages as we know it today only provides a small insight into the cooking traditions of this epoch. Not only covers the term "the Middle Ages" a time frame of at least 1000 years but there are also social factors that prevent a comprehensive history of cooking for that time. Depending on the historical discipline beginning and end of the epoch vary to a great extent. For our convenience we frame "the Middle Ages" with the dates 500 to 1500. The starting point is meant to suggest that the influence of the ancient Roman Empire on contemporary cooking has passed, the end point marks a distinct shift in cookbook production when printers discover that these books can be sold very easily (the first German cookbook is printed 1485). Their craft had a serious impact on this text type. Nevertheless, the core characteristics of medieval cooking – humoral dietetics and cooking conform to Ordinary Time – still affect the kitchens of the following centuries. The social background of medieval recipes is always and exclusively the upper class, the religious and secular nobility as well as rich townsmen. Although we do have information, albeit secondhand, on the alimentation of peasants and the poor, we do not have cooking recipes that relate to that social class.

This paper will focus on German language cooking recipes, the corpus of which comprises 60 recipe collections with approximately 6000 recipes, that have been recorded in handwriting between 1350 and 1500. They convey characteristics of medieval and early

modern cooking from the 10th to the 17th century. This paper will give a short introduction to the herbs and spices used in medieval German cooking recipe texts, and we will discuss the role herbs and spices played in the kitchen of that time. In this paper we will focus on a select few collections that have been recently edited and semantically enriched to provide a proof of concept for an experimental research method into the flavour of medieval cooking. In that context we want to provide flavour profiles not only for medieval dishes but also for the kitchen of humors by applying Digital Humanities research methods.

Medical and dietetic background

Leaving the obvious alimentary effect aside, medieval cuisine was intensely focused on dietetics and health care. In the Middle Ages food and drink are believed to be one of the primary sources for maintaining health. In this context *regimina sanitatis* literature summarises ancient lore on the properties of drink, food and cooking.[1] The underlying concept is the theory of humors:[2] it describes the whole universe by setting all things within a gradation system of the primary qualities cold, warm, dry, and moist. It is the centre of medieval western medicine and has been handed down in the beginning through clerics and monasteries and later through the medical personnel of that time. The roots reach back into antiquity, but the peak of philosophical discourse on this topic lies in the Middle Ages. Within the framework of monastic medicine in the early Middle Ages, ancient Mediterranean traditions were extended to include European-Alpine ones. In the High and Late Middle Ages, the influence of Arabic teachings on medicine, which by then were already scholastic discussions, increased greatly and spurred these thoughts.

Medieval thinking is profoundly dominated by Christian religion, and this is also and especially true for everything that concerns man and the nature surrounding them: four elements rule the macrocosm, i.e. the world surrounding us. Hildegard von Bingen, a nun who has taken very individual paths in her occupation with monastic medicine, explains:

> God also created the elements of the world. They are in humankind, who lives with them. They are called fire, air, water and earth. These four basic elements are so closely connected and bound together that none can be separated from the others. Thus they hold so closely together that one can call them the building blocks of the cosmos.[3]

The theory of the elements is therefore also applied in the medieval understanding of man: The ground rule is the idea that the human organism itself and the substances beneficial for its healing can be described with the same qualities. The human being – and all things in nature – are understood as microcosms within the macrocosm. They are thus the image of the elementary world on a reduced scale. Eventually a consistent theorem emerges that interlinks medical lore with socio-economic-religious systems to an overall

philosophy of a whole period.[4] So, for example, foreign and expensive spices are more suitable ingredients for upper class clerics and nobility, whereas local herbs are hardly ever used in food preparation of the rich.[5]

The main aims of this medical theory are to stay healthy through constant prophylaxis especially in the fields of the *sex res non naturales* and to work on a balanced household of humors that, ideally, is moderately warm and slightly moist. The mix of humors in a person strongly relates to internal (gender, age, etc.) and external (time of the day, season of the year, etc.) factors. Dietetic texts suggest ways to temper foodstuff to provide better food tolerance in respect to the complexion of the luncher. Cooking recipes do follow the humoral theory but in general this information is hidden in the cooking instructions, in the properties that ingredients add to a food, but are sometimes even accentuated through an author's remark. Herbs and spices are potent means to alter the humoral status of foodstuff.[6]

The role of the medieval chef was to prepare meals that support the health of his master and sometimes even his guests. However, he was also meant to provide good food.[7] In around 1350 Konrad of Megenberg, a well-known religious and economic author of his time, explained the rules of keeping house. He detailed the areas of responsibility for each member of the household, therefore also for the cook: "A chef is an expert in differentiating tastes, he knows which spices can be selected and how to mix, cook and roast."[8] He describes how the cook takes care of various dietetic aspects in context with preparing and even serving the food. In order to provide balanced food, a cook had to know about the complexion of the eater and about humoral theory which provides gradations (The 1st degree indicates the lightest, the 4th or 5th degree destructive or even lethal effect.) for the primary qualities of foodstuffs, cooking processes, etc. Similar to an equation, the primary properties of foodstuffs and preparation methods complement each other as well as the humoral profile of the eater.

Herbs and spices in the Middle Ages

The culinary culture of the Middle Ages evolves in a continuous process from Roman and ancient eating habits.[9] Unfortunately, we can only trace these culinary developments from the most recent Roman to the oldest medieval traditions, because, due to a nearly 1000-year gap in tradition, we lack the necessary evidence. Nevertheless, a comparison of the oldest medieval recipe collections from France and Italy with the collection attributed to the Roman Apicius clearly shows distinct change in the use of herbs and spices: while the use of pepper and cumin declines, ginger and saffron are used more frequently.[10] Like Apicius' recipes the oldest surviving medieval recipes present an extraordinarily creative cuisine, which prefers to emphasize changes in taste, color and form of the basic ingredients. It often claims a surprise effect which manifests itself especially in so-called 'show dishes', as a central feature of this preference is the use of luxurious herbs and spices as they emphasise

a certain level of social standing. The medieval recipe collections demonstrate that food has long since left behind the purpose of a purely life-supporting process and that the entertainment value, which targeted all available senses, must be seen as an equal, if not the more important factor.

If one wanted to describe the aroma of the food of the medieval upper class, the only valid comparison would be the cuisine of the Middle East, in which comparable spices are still preferred today.[11] At the same time, however, the rumor must be contradicted that the taste of medieval food developed from contact with Arabs in the course of the Crusades: it is the product of a continuous development, and eastern spices had long been known from medical recipes. Arab contacts are only relevant in regard to the spice trade until European merchants directly deal with Asian sellers.[12] The high prices resulting from the long transport routes and the surcharges of the innumerable middlemen turn spices into luxury items that could only be purchased by rich households. There, spices were not only used for flavouring food:

> Spices soothed and cheered, creating a refined environment of taste and comfort. They could be consumed in edible form or breathed as perfume or incense. The odor of spices wafted through houses fumigated with burning aromatics, as a kind of predecessor to aromatherapy. Churches were also permeated by the odor of resinous spices, especially frankincense, used in the celebrations of the Christian liturgy.[13]

The use of spices can be interpreted as a means of representation, but this is less evident in the quantity used than in the varieties of spices used. Saffron, for example, ranks at the upper end of this scale, due to its costly production, while pepper – especially in the late Middle Ages – was a comparatively cheap spice used throughout all classes; its role as a means of payment certainly contributed to this. In order not to have to do without the pleasure of an extraordinary, prestigious spice, new varieties of pepper were imported, such as long pepper (*Piper longum*), Malaguet pepper (*Aframomum melegueta*) or cubeb pepper (*Piper cubeba*), and offered to the richest as correspondingly luxurious products. The same can be said for various other imported spices. In addition, a larger selection of spices can generally be assumed for rich households than for less wealthy ones.[14] And above all that, foreign spices added a certain amount of mystery and adventure to a dish.[15]

Research on a corpus of 6 select recipe collections that hand down 365 German cooking recipe texts from the late medieval period provides an interesting overview of medieval flavouring habits (see Figure 1).[16] A little less than 10% of the recipes do not contain any seasoning instructions at all. In the majority of recipes, about 40%, adding herbs and spices is only implicitly required, the standard phrase for that is "season it well". A result of this study is that implicit flavouring instructions generally refer to pepper, ginger, cinnamon,

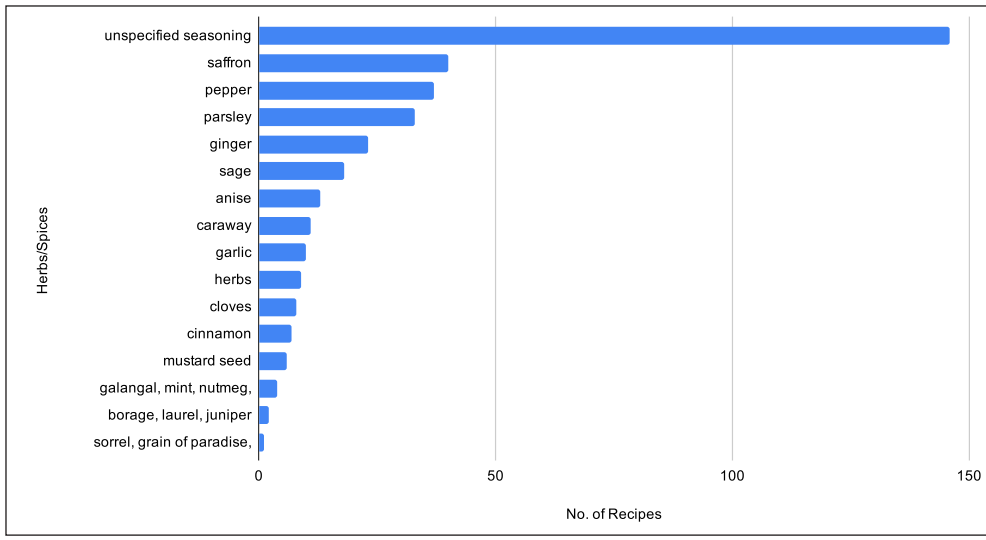

FIGURE 1. A list of Spices used in German medieval cooking recipe collections.

and cloves. Saffron (10.13% of total flavouring instructions in 10.96% of the recipes) is the most called for spice and primarily used for colouring, closely followed by pepper (9.37%, second most common spice in 10.14% of the recipes). Other but less frequently used spices are ginger (5.82%), cloves (2.03%), cinnamon (1.77%), and galangal (1.02%). Domestic herbs and spices, however, are mentioned with a distinctly lower frequency. Although parsley is the third most common spice (8.35%) it is only used in 33 (9.04%) recipes, and it is used to obtain green colouring of food rather than aroma. Sage, aniseed, caraway, garlic, or unspecified 'herbs' are called for even less frequently. All in all, the use of imported vs. domestic spices is well balanced (123 vs. 119) when the unspecific flavouring instructions are left out of the equation. If we do assume that unspecified flavourings generally refer to imported spices, these are used in more than two thirds of the recipes.

Research background

In the international research project *CoReMA*, located at the University of Tours, France, and the University of Graz, Austria, we are researching possible connections of the medieval French and German cuisines.[17] The aim of the project is to anew, or for the first time, edit all medieval German, French and Latin manuscript recipe collections before 1500 and describe them with codicological metadata. The texts are semantically enriched with information on text composition, ingredients, tools, and dishes. This data, especially the combination of ingredients, will be the basis to learn about recipes common to both cuisines and their possible migration.

The basis for the enrichment is normative data that is tied into the linked open data cloud via Wikidata. Wikidata, launched in 2012 to establish a common knowledge base

and provide structured data for all of the different languages in Wikipedia, Wikimedia Commons and other foundation projects, has evolved into a multi-disciplinary, machine-readable, centralised and linked knowledge hub used for ever increasing use cases, especially within the Life Sciences[18]. The emphasis of this datahub lies on the creation of abstract semantic web concepts and on the normative structuring of the data, both of which create access points from different research angles. Therefore the annotation of the historical texts with reference numbers from Wikidata provides not only the possibility to compare the content of different language texts but additionally opens a door into the world wide web of linked open data. The interconnection of different databases via these numbers creates a nearly infinite web of knowledge.

For the *CoReMA* project we make use of data from different ontologies and databases[19] as well as transformed data from books into databases.[20] For the present article we use the Wikidata reference numbers to link to databases holding information on the aroma molecules of various foodstuffs.[21] This provides us with access to big data repositories, containing data that complements our small sliver of knowledge. The use cases of these databases normally lie in scientific big data research or economic purposes that mostly aim at quantitative content analysis. This data has already been successfully used in studies that compare the flavour of different cuisines.[22]

The aroma of foodstuff is generally composed from hundreds of different aroma molecules, but there are only a few key flavour molecules that dominate the flavour of an ingredient, while other molecules add to and round off the aroma of a certain ingredient.[23] To focus on that qualitative aspect we have built our own database on the basis of the modernist cookbook by Vierich/Vilgis *Aroma*,[24] which provides these main flavour molecules, and several databases that add to this information. The combination of different resources aims at the completeness of the data and also allows for a better data curation. While the verbal description of the individual molecules makes an in depth characterisation of the foodstuff possible, the flavour groups provide the means to calculate the flavour profile of a group of ingredients (e.g. all herbs and spices that have the humoral primary qualities warm and dry) and also give a verbal aroma summary of a dish, which normally is composed of several ingredients.

Our resource holds information on herbs and spices relevant to medieval cuisine. It lists the main aroma molecules of ingredients, verbally describes the molecule's flavour profile, and relates the molecules to eight distinct flavour groups (Figure 2). In these groups aromatically and chemically related flavour molecules are gathered. Following the verbal description, flavour groups 1-8 range from a light, volatile to a deep and dark aroma; group 9 collects molecules that stimulate the trigeminal nerve with hot, warm, cold, or adstringent sensations. The group characteristics allow a short, summarising description of an ingredient: Parsley smells grassy-green, citrus-fresh with a warm aromatic undertone

Group	Group name	Flavour description
1	aliphatic compounds	waxy, green, mushroomy, fruity
2	linear sulfur nitrogen compounds	sulfurous, cabbage, onion, horseradish notes
3	acyclic terpenes	citrus, fruity, floral
4	cyclic terpenes	balsamic, camphor, woody
5	sesquiterpenes	dark, heavy-floral
6	aromatic compounds	deep and aromatic
7	phenols, phenolderivates, phenylpropanoids	Cinnamon, Nutmeg and co.
8	heterocyclic compounds, hydrocarbons, amides, macrocycle	roast flavours
9	trigeminal stimulus	no aroma

Figure 2. Distinct flavour groups and their verbal flavour description.[29]

(Figure 3). The visualisation of the flavour profile (Figure 4) shows that parsley aroma spikes into three different directions, an emphasis lies on acyclic terpenes, a citrus, fruity, floral odor. With this information we are not only able to name the predominant flavours of a dish, or describe the aroma with a suitable vocabulary but we can also use the distinct flavour groups to visualise the aroma of an ingredient on a radar chart to get a better grasp on the positioning of an ingredient or dish within these nine flavour poles.

Flavour group	Flavour group aroma	Molecule	PubChemID	Vierich/ Vilgis	FooDB	FEMA
1	waxy, green, mushroom, fruity	(Z)-HEX-3-ENAL	6428782	green-grassy		
3	citrus, fruity, florid	1,3,8-P-MENTHADIEN	176983	grassy-spicy		
3	citrus, fruity, florid	LIMONEN	440917	orange, terpen lemon	mint, lemon, citrus, orange, fresh, sweet	citrus, mint
6	deep, aromatic	MYRISTICIN	4276	spice, warm, balsamic	balsamic, spice, warm, woody, balsam	

Figure 3. Tabular flavour profile of parsley (Wikidata Q65522500).

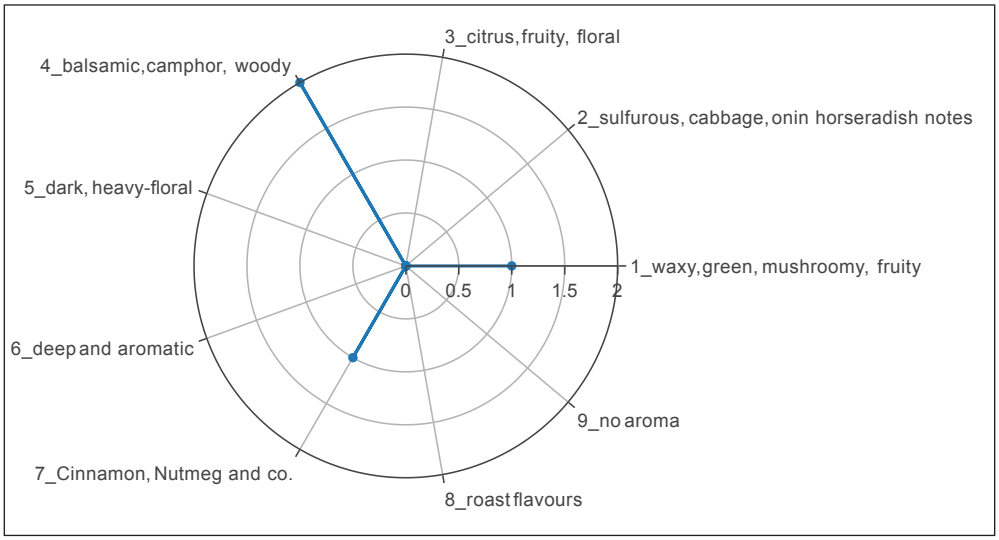

FIGURE 4. Flavour profile of parsley as radar chart.

Calculating flavour of medieval dishes

In respect to historic cuisines, our research into a description of food aroma is highly experimental. Although we believe that our approach towards the aroma of medieval food focusing on qualitative results can provide relevant findings, these cannot be generalised or reviewed without certain constraints. The most obvious of these is the fact that we have no access to medieval ingredients and their historic aroma profile, which can be assumed to differ greatly from modern ones. It may well be only the aroma of herbs and spices that has not substantially changed over the centuries. Another constraint is how to deal with flavour in a medieval context, as we have only sketchy knowledge on how medieval man perceived flavour: While in the scholastic domain taste/flavour/odor were regarded as rather abstract aspects of humoral theory, there nevertheless are positive and negative references to flavours and odors in literary texts.[25] German cooking recipe texts do not refer to the flavour of food at all. An additional, albeit temporary, drawback is that at the moment our database on the flavour of medieval cooking ingredients only holds a selection of medieval ingredients (certain herbs and spices, for which the relevant data was available) – vegetables, meat, dairy products etc. are missing. Furthermore, the data available only describes the fresh, unprocessed ingredients; the influence of cooking processes is not incorporated. We are able to calculate with the most fragrant ingredients but at the moment we can only work with select recipes.

All in all, these factors have to be duly noted but they will not prevent interesting findings to questions that have not been asked this way before. We DO NOT aim at creating historic flavour profiles! Our foremost aim is to produce a modern flavour profile

to add information to select research questions; an additional goal is to possibly gain another distinct factor for recipe comparison between different cuisines – this may be the cuisines of Germany and France, but it might also support the characterisation of different recipe collections.

Our flavour profile is an abstraction of food sensorics: the aim is a visual characteristic of a food or foodstuff instead of a verbal description, the results are not derived from a tasting process but calculated from the data in our database. The underlying assumption, which is also used in aroma pairing, is that flavour molecules from a distinct flavour group add up and their characteristic aroma intensifies.[26] This approach can be used for both calculating with the flavour profiles of individual ingredients as well as a combination of ingredients which are needed for a certain dish: matching molecules/flavour groups are simply added up. The result of the calculation will be a distinct positioning of an ingredient within the eight flavour groups, or respectively, on the eight-axis radar chart.

Analysis

Question: How are the flavour profiles of medieval herbs and spices distributed on a radar chart?

Our flavour database holds 44 ingredients, the majority of which (38) are herbs and spices. A rather even distribution on the flavour chart (Figure 5) was to be expected. Nevertheless, there is a distinct spike towards balsamic, camphor, and woody aroma not only in count but also in herbs and spices containing flavour molecules from group 4. Interestingly, similar evidence comes from contemporary literature or the bible,[27] which praise the aroma and virtues of the spikenard as a queen of herbs. *Nardostachys grandiflora* is a herb native to

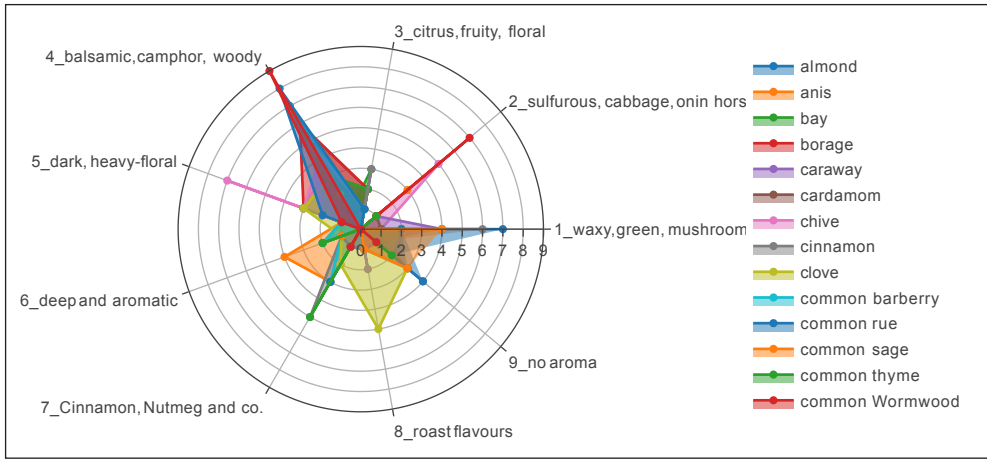

FIGURE 5. Flavour profiles of all medieval herbs and spices in our database.

the Himalaya region, substitutes in Europe were valerian spikenard (*Valeriana celtica*), valerian (*Valeriana officinalis*) and also spike lavender (*Lavendula latifolia*). All three have a pungent, musky, balsamic, medicinal odour. The results of this analysis strongly correlate with information from very divergent sources. We take this as an indicator for the potential of this analysis. Considering the constraints listed above, this way of looking at historic food indeed provides new insights.

Question: How can we describe the flavour of the humors?

Herbs and spices are generally used for adjusting the humoral properties of food, either as ingredients in a dish or as ingredients in sauces that are served alongside the main dishes.

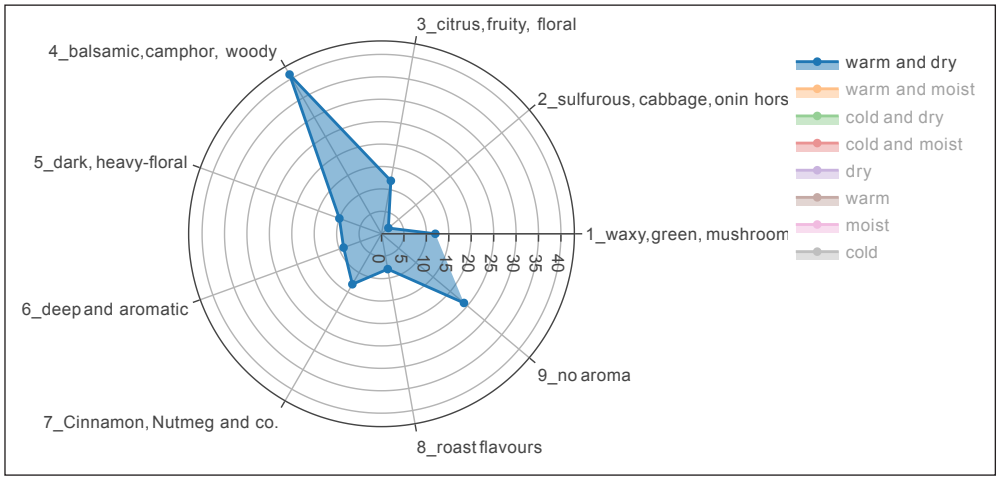

FIGURE 6. Flavour profiles of the humoral primary quality warm/dry.

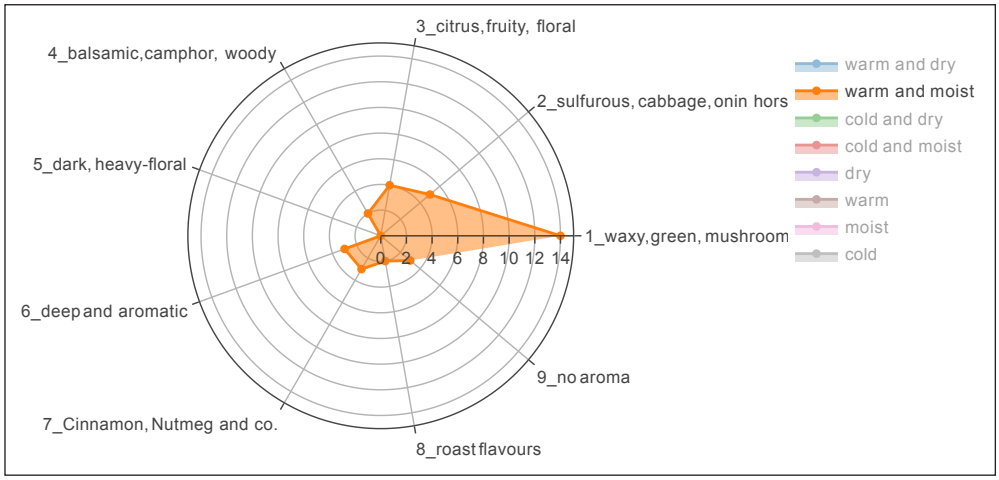

FIGURE 7. Flavour profiles of the humoral primary quality warm/moist.

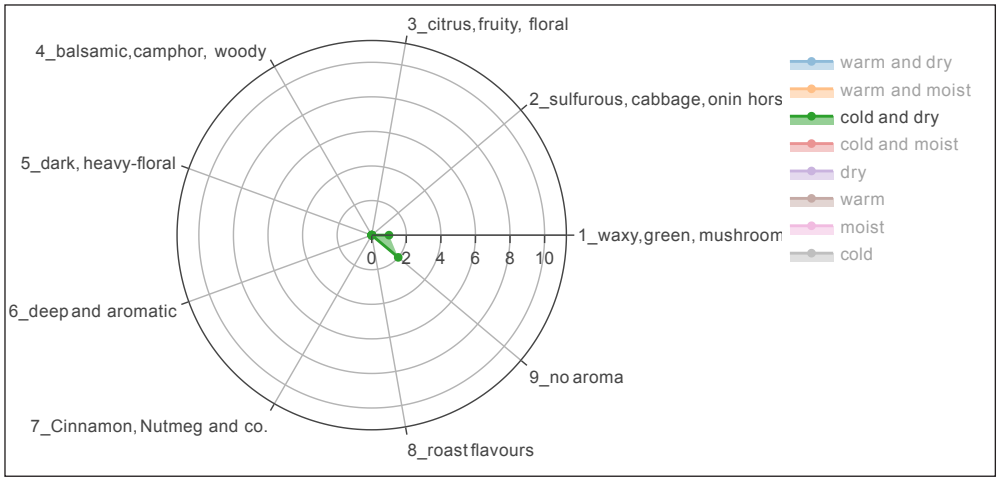

FIGURE 8. Flavour profiles of the humoral primary quality cold/dry.

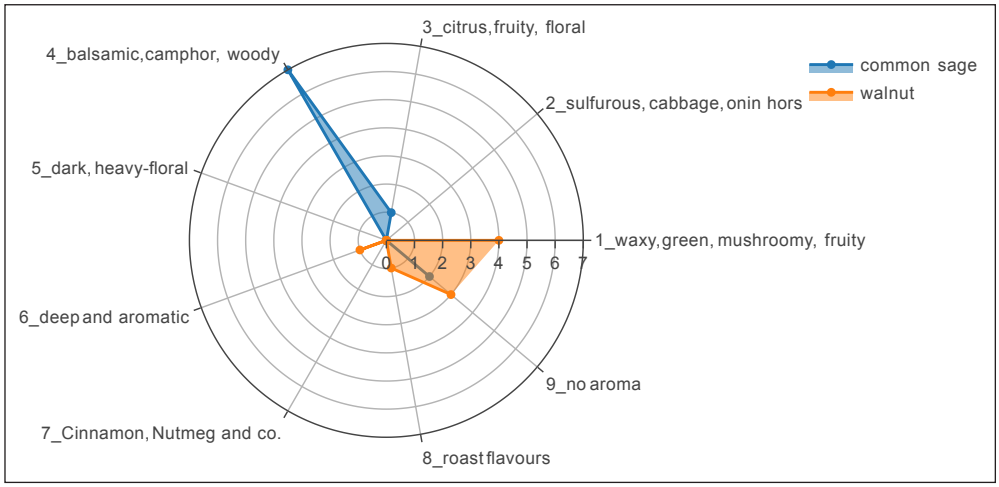

FIGURE 9. Flavour profile of select recipe "Sauce of Sage and Walnut".

The radar chart proves the fact that most herbs and spices are humorally warm and dry (Figure 6). It also shows that this category is distributed nearly evenly in the flavour groups but there is a very intense flavour spike at group 4 and a moderate one at group 9; there are no flavours from group 2. The first describes the pungent, musky, balsamic, earthy odour discussed above, the second groups molecules that trigger a trigeminal stimulus, which in this case most likely is the hotness of certain spices. Herbs and spices with warm and moist prime qualities (Figure 7) tend to the more volatile flavour groups with a distinct spike to group 1: waxy, green, mushroom flavours. Only very few herbs and spices in the database are cold and dry (Figure 8). The flavour sensation with these lies on a trigeminal stimulus.

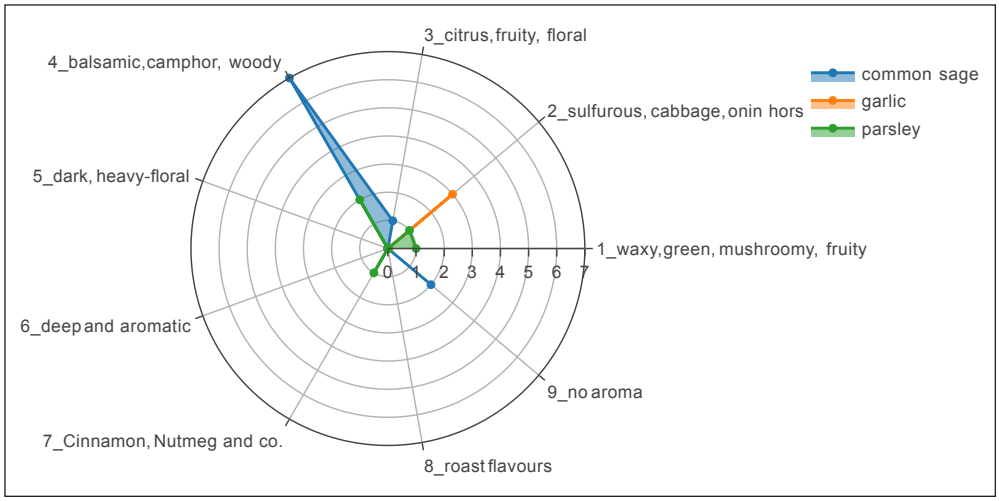

FIGURE 10. Flavour profile of select recipe "Sauce of Sage, Garlic, and Parsley".

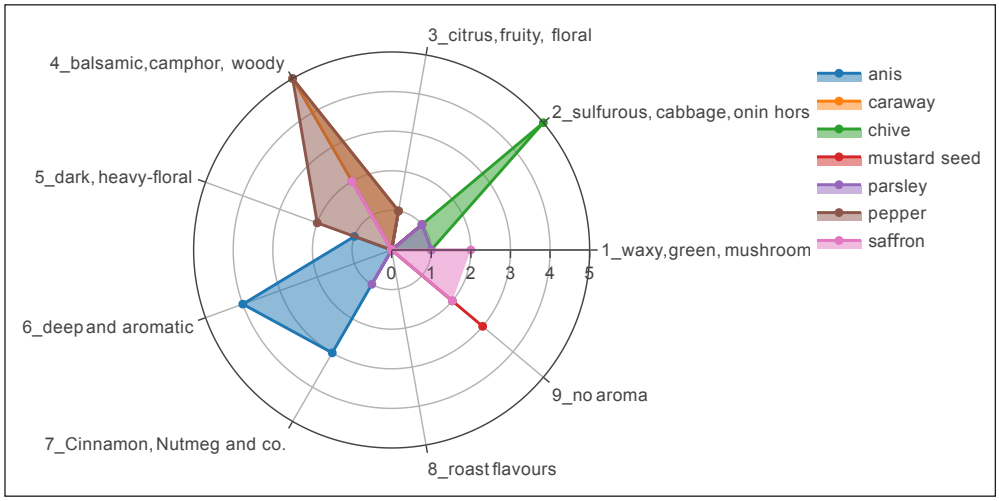

FIGURE 11. Flavour profile of select recipe "Mustard Sauce".

There are no cold and moist herbs or spices in our database. It is very illustrative that the different prime qualities can be associated with distinct flavour profiles.

Question: What is the flavour profile of select medieval recipes?

For this we have selected four diverse recipes containing ingredients that are documented in our database. As expected, the visualisation of the recipes produced also very diverse flavour profiles. Three recipes are for sauces (sage, garlic, mustard), one recipe is for a main dish, a so-called 'almond hedgehog'. The flavour profiles for the sauces have extreme spikes

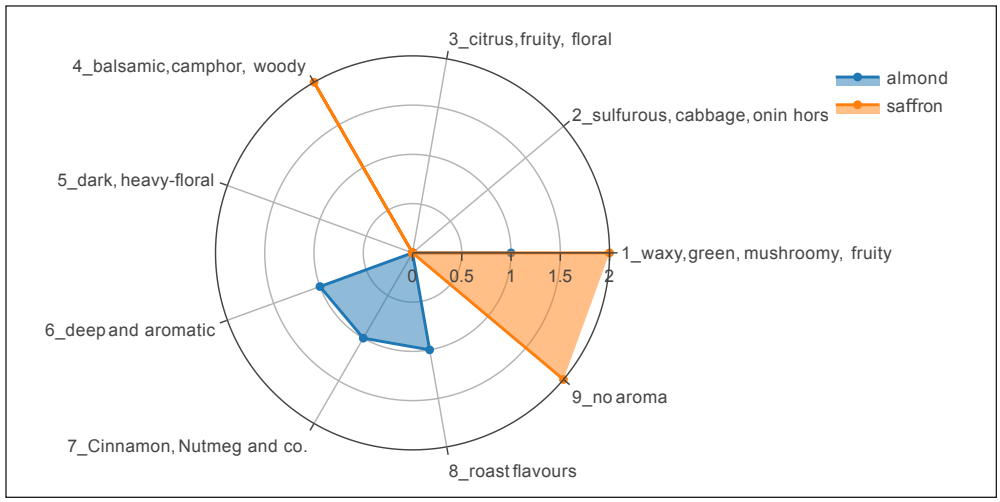

FIGURE 12. Flavour profile of select recipe "Hedgehog of Almonds".

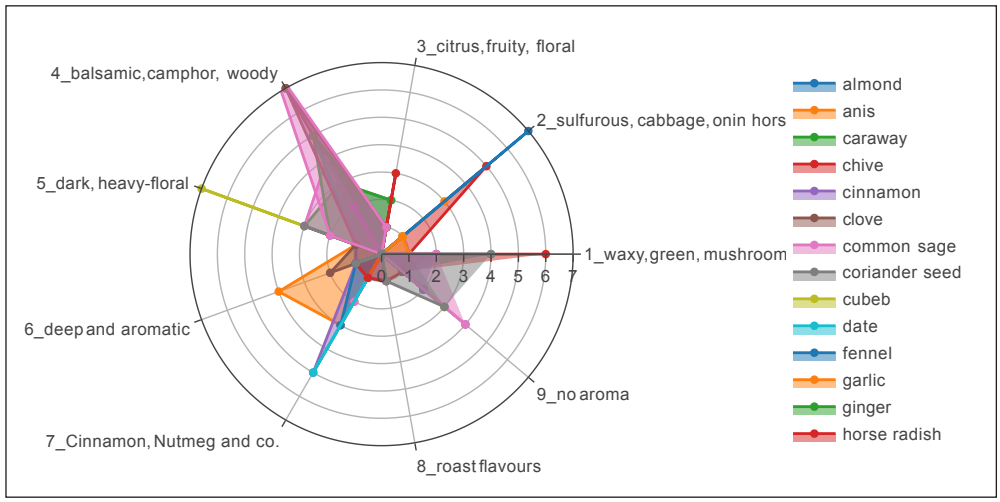

FIGURE 13. Flavour profile of the select recipe collection Bs1.

towards different flavour groups: the sage-walnut-sauce (Figure 9) has slight aromatic (6), green (1) notes and spikes towards the inevitable balsamic notes (4). The garlic sauce (Figure 10) has, of course, sulfurous (2) flavour but spikes again towards the balsamic notes (4). A very interesting flavour profile can be attributed to the mustard (Figure 11), it shows moderate, and evenly distributed but pronounced spikes towards four flavour groups (2, 4, 6, 9). The almond recipe (Figure 12), on the other hand, has a rather evenly distributed flavour profile of deep aromatic to roast flavour notes (6,7,8) that are accompanied by waxy, green (1), balsamic and camphor notes (4).

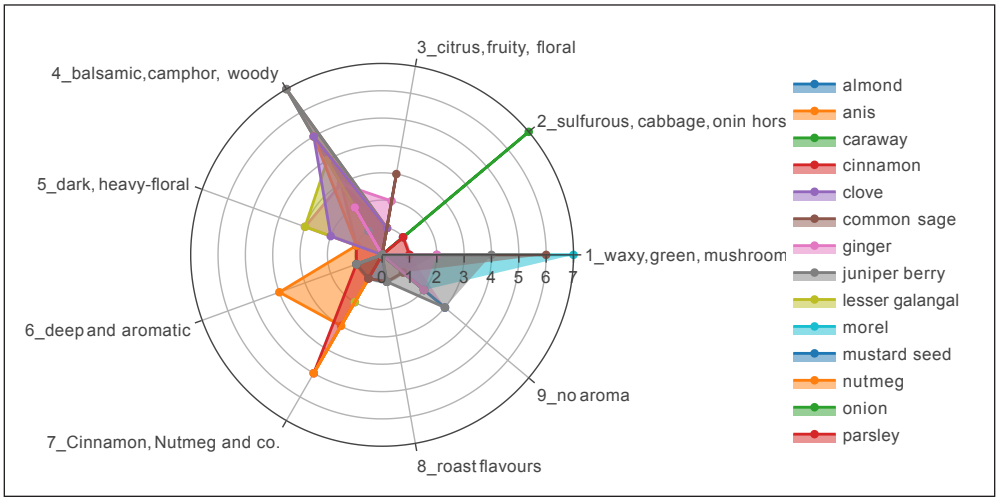

FIGURE 14. Flavour profile of the select recipe collection Gr1.

Question: Can the flavour profile of the ingredients be used for a comparison of recipe collections?

The 60 medieval recipe collections hand down ca. 6000 recipe texts, only a moderate percentage of these are individual recipes, the others are parallel transmissions. The working assumption for a comparison of recipe collections would be that they hold many similar recipes, thus naming similar ingredients from which a similar flavour profile can be calculated. A comparison of two collections (Bs1, Figure 13, and Gr1, Figure 14), that hold nearly the same number of recipes, and that are known to pass down similar recipes, produced a surprising result: Bs1 is much richer in the use of herbs and spices. This is especially obvious for group 2 where Gr1 only has onion and Bs1 onion, garlic, and horseradish. The differences may be explained with the different social background of the collections: Gr1 probably was collected and written down in a rural monastery, Bs1 is attributed to the personal chef of Ulrich V., count of Württemberg. The results of this comparison are also highly promising for verifying existing theories on cooking recipe collections, but they are also bound to open up new research questions.

Conclusions, perspectives

The analysis of the humors, select recipes and recipe collections provides compelling insights into these medieval cultural sources. A flavour profile of the herbs and spices grouped by their humoral attributes yields distinct differences aligned to their prime qualities. Although we will not be able to describe the flavour of medieval dishes, the flavour profiles of herbs and spices named in the recipes allow to draw comparisons with other historic, in our case literary, sources. Most surprisingly, the results strongly overlap. The comparison of

the flavour profiles of select recipes as well as the comparison of the profiles calculated for recipe collections hint at a great potential of this research method: the visualisation of the flavour profiles allows a differentiated approach towards texts and collections that is not only a text based comparison of ingredients but that is driven by visual impressions.

The proof of concept analysis has clearly shown the potential of our approach of calculating flavour profiles to get more insight into historical cooking recipes. Therefore, the next steps will be the expansion of our flavour database and a general alignment of our data so that we will be able to analyse more recipes. Additionally, we want to implement an automated service for recipe comparison in the context of our project website.[28]

Notes

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