



Scientific Paper

Preparation methods influence gastronomical outcome of hollandaise sauce

Guro Helgesdotter Rogns^{a,b}, Morten Rathe^a, Morten Thyregod Paulsen^c, Mikael Agerlin Petersen^b,
Dagmar Adeline Brüggemann^d, Morten Sivertsvik^{e,*}, Jens Risbo^b

^aThe Culinary Institute of Norway (Gastronomisk Institutt), Richard Johnsensgate 4, 4021 Stavanger, Norway

^bDepartment of Food Science, University of Copenhagen, Rolighedsvej 30, 1958 Frederiksberg C, Denmark

^cNofima AS, P.O. Box 5003, 1432 Ås, Norway

^dFaculty of Life Science, Hochschule Rhein-Waal, Marie-Curie Straße 1, 47533 Kleve, Germany

^eNofima AS, P.O. Box 8034, 4068 Stavanger, Norway

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Abstract

Egg yolk stabilized butter sauces, such as hollandaise sauce, are classics in the French cuisine and adopted all over the world. They can be made using a number of different procedures. This study was done to determine how common butter sauce preparation methods influence perceptual parameters such as texture, mouthfeel and flavor. The goal was to evaluate the effects of the various preparation methods in order to gain control of the process and obtain the desired sauce properties. Five model sauces, prepared with the same amounts of ingredients, but with different procedures, were produced and analyzed. Sauce preparation methods differed regarding the amount of mechanical treatment, order of addition of ingredients, ingredient temperatures and states reached during production. The five model sauces were analyzed by particle size distribution, water and airiness measurements, microscopy, color measurement, descriptive sensory analysis and analysis of volatiles. Results demonstrated large differences between the explored types of hollandaise sauce, with texture and mouthfeel properties varying significantly with different preparation techniques. This study also included feedback from experienced chefs regarding their habits related to hollandaise sauce preparation.

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Introduction

Relatively few studies have focused on the culinary perspectives of butter sauces (Nygren et al., 2001; Perram et al., 1977; Rapp et al., 2007; Small and Bernstein, 1979; Weenen et al., 2003), although sauces are characterized as a fundamental element in classic French cuisine. Julia Child even stated: “Sauces are the splendor and the glory of French cooking” (Child et al., 1961).

According to Larousse (Larousse, 1993), the most important sensory qualities of sauces are “color, luster, aroma, taste, texture and viscosity”, thus underlining the importance of the sauce in a dish.

Carême (1783–1833) is said to be the origin of many of the sauces in the French cuisine. In addition to sauce creation, he also classified the French sauces, and sorted them into groups derived from what he called four mother sauces (Larousse, 1993; Peterson, 2008); béchamel, allemande, espagnole and velouté. Escoffier (1846–1935) later adopted and rearranged Carême’s classification, and also added one more sauce to the list of mother sauces. In Escoffier’s system, the mother sauces were; béchamel, espagnole, velouté, hollandaise (and mayonnaise) and tomato sauce (Peterson, 2008). Sauces based on one of the mother sauces were called secondary, small or derivative sauces, and they are still numerous in the French cuisine.

*Corresponding author. Tel.: +47 51844637.

E-mail address: morten.sivertsvik@nofima.no (M. Sivertsvik).

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According to the system, béarnaise is a secondary sauce of hollandaise sauce. This classification of sauces is referred to as “the French sauce system” (Larousse, 1993).

Egg stabilized butter sauces are structurally similar, and differ mainly regarding the aromatics used to impart sauce flavor. General sauce ingredients are egg yolks, butter and an aqueous phase containing acid and aroma depending on the sauce type. The sauces normally also contain salt, and sometimes freshly ground pepper, either black or white. Hollandaise sauce and its derivatives are used both to accompany fish, meat and vegetables, which make them quite versatile. These sauces contain high percentages of milk fat, and butter incorporated into sauces is known to make sauces “lighter, smoother, glossier, thicker and mellower” (Rapp et al., 2007). The egg yolk is a key ingredient in hollandaise sauce, due to its emulsifying and stabilizing properties. Nonetheless, these butter sauces have a reputation for being difficult, because of their instability, which is why few make them from scratch at home.

From a scientific point of view, a hollandaise sauce is a colloidal suspension of oil in an aqueous phase, called an oil-in-water (O/W) emulsion (McClements, 2005). As the sauces contain varying amounts of air bubbles, they can also be characterized as foams. The oil phase of the emulsion, called the dispersed phase, consists of butter fat and egg yolk lipids (Perram, et al., 1977). The continuous phase, into which the fat is dispersed, often consists of a wine reduction, with various amounts of vinegar. From a chemistry perspective, this phase can therefore be characterized as an aqueous solution of acids, depending on the ingredient choice. The emulsion is created by mechanical treatment, where the oil phase is broken down to small droplets incorporated into the continuous phase. The size of the droplets depends on the emulsification power and tool of choice, which influences the viscosity of the final product (Kilcast and Clegg, 2002). The viscosity is also influenced by the amount of air and fat incorporated into the sauce (Kilcast and Clegg, 2002; McGee, 2004).

Culinary practice and molecular gastronomy often focuses on how the choice of ingredients influences the final product. In contrast to this, the procedure is the field of interest in this study, because there are many different ways to make an egg yolk-stabilized butter sauce. It is improbable that these different ways of making sauce yield identical sauce structures. The hollandaise sauce process may vary on several levels; the mechanical treatment, the order of addition of ingredients, the ingredient states and the temperatures reached during preparation. These preparation variations may influence sauce parameters such as texture, mouthfeel, appearance and aroma.

The aim of this study is to evaluate and quantify the differences in texture and flavor originating from different butter sauce preparation methods. In his book *On Food and Cooking – The Science and Lore of the Kitchen* (McGee, 2004), Harold McGee describes different methods for making egg yolk stabilized butter sauces. Inspired by McGee, we used five distinct sauce-making techniques to create model sauces, using the same composition of ingredients for all. The explored methods represent both old and new techniques, preparations using different tools and the difference between addition of warm and cold butter. The experimental setup

gives less emphasis on the effect of continuous variation of single procedure parameters.

Materials and methods

Product development took place as a preliminary step in order to create the model sauces. As McGee refers to the original recipes of Carême (Carême, 1854, 2006) and Escoffier (Escoffier, 1921, 2009) in his book, these recipes were consulted. Carême's recipe originated in his book “L'Art de la cuisine Française au dix-neuvième siècle” first published in 1854 (Carême, 1854, 2006). Escoffier published his recipe in the book “Le guide culinaire” in 1921 (McGee, 2004). There are several special features of these sauces. In Carême's recipe, a wooden spoon is used to incorporate butter into the sauce, which would result in a less airy sauce than made with a balloon whisk. Carême used whole butter and flavored the sauce with salt, pepper, vinegar and nutmeg. The temperature of the butter was not specified. In Escoffier's method, the tool is not specified. However, the French word *monter* is used to indicate how the butter should be incorporated, which means to mount, raise or lift in English. The sauce is “lifted” with butter, but it is unclear whether this reflects the manner of incorporation or if it reflects the taste. Escoffier writes that both whole and melted butter can be used. Escoffier flavored his sauce with vinegar, salt, pepper and lemon juice. None of the recipes specify temperatures for sauce intermediates, nor ingredients.

Traditionally, butter sauces have been made by hand, in a saucepan or over a *bain-marie*. Today, the normal tool to use is a balloon whisk, where the number of wires and beating rate influences the oil droplet size in the emulsion, in addition to the degree of air incorporation. While butter sauces are normally made using hand power, hand-made sauces represent too much variation for research purposes. In this study, hollandaise sauces were standardized using an induction stand mixer (Kenwood Cooking Chef, Kenwood Electronics Europe B.V., Uithoorn, The Netherlands, <http://www.kenwood.com>). An immersion blender (Bamix Gastro 200, bamix of Switzerland, Switzerland, <http://www.bamix.com>) was used to finish one of the sauces (Mayonnaise). The application of these machines resulted in more rigorous beating of the emulsions than what is normal when making butter sauces by hand. One might therefore expect smaller oil droplets and maybe also more incorporated air in these sauces compared to hand-made ones. To ensure the relevance of the model sauces, trained chefs were involved in the sauce development phase. The aim was to make model sauces resembling professional hand-made sauces.

Sauce recipe

All sauces were made using the same ingredients and amounts, in order to compare preparation methods (see Table 1).

If one assumes that the egg yolk contains approximately 49% water (Belitz et al., 2009), the total water content in sauce ingredients was 23,8% (water content in the clarified butter was disregarded), which is sufficient water phase ratio to

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