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A new espresso brewing method

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ABSTRACT

A new espresso brewing method has recently been developed. The main steps are: introduction and tamping of ground coffee in a sealed chamber, introduction of pressurized air into the chamber, the introduction of hot water and a pre-infusion phase. It is substantially different to the usual brewing method used in bars: the driving force for the flow is the pressure difference between the interior and the exterior of the chamber (rather than pressurized hot water provided by a motor-driven pump); the extraction process is partially static; the pressure is higher than the traditional method; and the temperature of the extraction chamber can be controlled (in addition to the water temperature control found in the traditional method). The method has been tested with three chamber temperatures and two pressures. At all settings, espressos produced using this method have particularly high and persistent foam. Furthermore, changes in pressure cause changes in some physical parameters and the amount of key odorants in the headspace above the coffee. A benchmark comparison with the capsule method gives differences in several aromatic compounds and in almost all the physical parameters. In conclusion, the beverage produced by the CF method is clearly recognizable by a thick and very persistent foam layer, while the method appears more flexible than the traditional one as the characteristics of the EC can be adjusted as a function of brewing conditions.

1. Introduction

A very large number of espressos coffees (EC) are brewed every day in the world. It has been estimated that over than 50 million cups per days are consumed (Illy and Navarini, 2011). Consequently, many coffee brewing apparatuses have been developed (Klopprogge et al., 2013) and it is known that different brewing techniques produce different espressos in term of quality (Parenti et al., 2014). The category includes all devices that are able to percolate pressurized hot water through a tamped cake of ground coffee, allowing brewing to occur (Illy et al., 2005). Specifically, there are three widespread technologies for brewing espresso: the bar machine (the traditional method), and the capsule and pod machines (simpler preparation methods). These two latter methodologies use a single dose of pre-packaged coffee powder, which requires less skill to brew the coffee. Capsules in particular provide good quality espresso; they reduce coffee powder aging, limit moisture effects on granulometry, and uncontrolled variability in other parameters, such as coffee dosing, torque applied to the cake, and water distribution on the powder (Illy et al., 2005; Parenti et al., 2014; Vanni, 2009).

Recently, a new espresso brewing method, namely Caffè Firenze (CF) (EU Patent 06 023 798.9; US 2010/0034942 A1) has been developed. This article describes this new brewing method, which uses a sealed chamber and pressurized air. It tests the effects of different brewing settings (i.e. pressure and temperature) on the physical and chemical parameters of EC, as parameters such as water temperature and pressure are recognized as being particularly important for the quality of traditional espresso coffee (Andueza et al., 2002, 2003). Furthermore, the method is compared to a capsule method in order to highlight differences in physical and chemical parameters between the new method and a commercial method.

2. Materials and methods

2.1. The new extraction device for Caffè Firenze brewing

To test the new Caffè Firenze (CF) brewing method, an extraction device has been developed, and consists of the following parts (Fig. 1):

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- An extraction chamber where coffee extraction takes place under sealed conditions, high pressure and controlled temperature.
- An electric compressor to feed pressurized air into the extraction chamber.
- An electric pump to feed pressurized water into the extraction chamber.
- An electric boiler to heat the water used for brewing.
- An electric resistance to heat the extraction chamber.
- A portafilter where the ground coffee is tamped, equipped with a manual valve allowing closure of the extraction chamber.
- Pressure and temperature transducers inside the extraction chamber.

2.2. Experimental procedure

The extraction temperature and pressure are the main operating parameters of the new brewing method. In our initial tests we brewed EC at pressures well above the standard pressure of 9 bar; these pressures were reached by means of compressed gas. Consequently, a series of preliminary trials were conducted that aimed to establish threshold temperature and pressure values which produced good-quality EC. Several tests were carried out at different temperatures and pressures, the latter achieved with different water-to-air ratios in the extraction chamber. The preliminary trials were assessed through, on the one hand, a sensory evaluation of the EC produced, and on the other, its refractive index, density and viscosity. The empirical results of these preliminary trials indicated the following minimum operating condition requirements:

- a minimum chamber extraction temperature of 75 °C;
- gas pressure inside the extraction chamber equal to or higher than 10 bar;
- a constant pressure increment of 5 bar in the water flowing into the extraction chamber;
- an infusion time of about 12 s.

On the basis of these empirical results, a series of experiments were performed at three temperatures (75, 80, and 85 °C) and two extraction pressures (15 or 20 bar) obtained through gas pressures of 10 or 15 bar respectively, with further water compression of 5 bar. The EC produced was compared on the basis of several chemical and physical parameters. All the boundary conditions other than temperatures and pressure were the same in all the trials.

Furthermore, a benchmark comparison was made with the capsule method as this system produces more consistent EC than the conventional bar method (Parenti et al., 2014). The data published in Parenti et al. (2014) was used for this purpose. It was possible to make a reliable comparison with the new method because the same coffee batch was used and all tests were performed on the same days.

2.3. Espresso coffee preparation

Each combination of settings (3 temperatures × 2 pressures) of the CF device was tested. Eighteen ECs per day were prepared over a period of three days, consisting of 9 independent replicates for each treatment, and making a total of 54 ECs to be analysed. On each day the order of preparation was randomized. According to Navarini and Rivetti (2010), water quality plays a key role in EC quality. Consequently, all tests were performed using the same commercial brand of mineral water, whose chemical and physical analysis can be found in Parenti et al. (2014). All ECs were prepared from the same batch of roasted coffee beans, provided by illycaffè S.p.A. (Italy). The beans were ground immediately before preparation, using a professional coffee grinder (KE640 model manufactured by Ditting Maschinen AG, Switzerland). The resulting particle size distribution was: 29% > 500 μm; 250 μm < 47.4% < 500 μm; 125 μm < 22.2% < 250 μm; and 1.4% < 125 μm, as determined by an automatic sieve shaker model Filter FTL 150–200 (Seneco Srl, Italy), equipped with four sieve (height 50 mm, diameter 200 mm).

2.4. Measurements and analyses

Coffee samples were collected according to the procedure reported in Parenti et al. (2014). Briefly, for all EC samples, about 25 g of percolated liquid was collected in a purpose-designed weighing bottle (75 ml volume, 53 mm internal diameter, 34 mm high). The temperature of the liquid was measured in real-time. The following parameters were analysed and evaluated for all

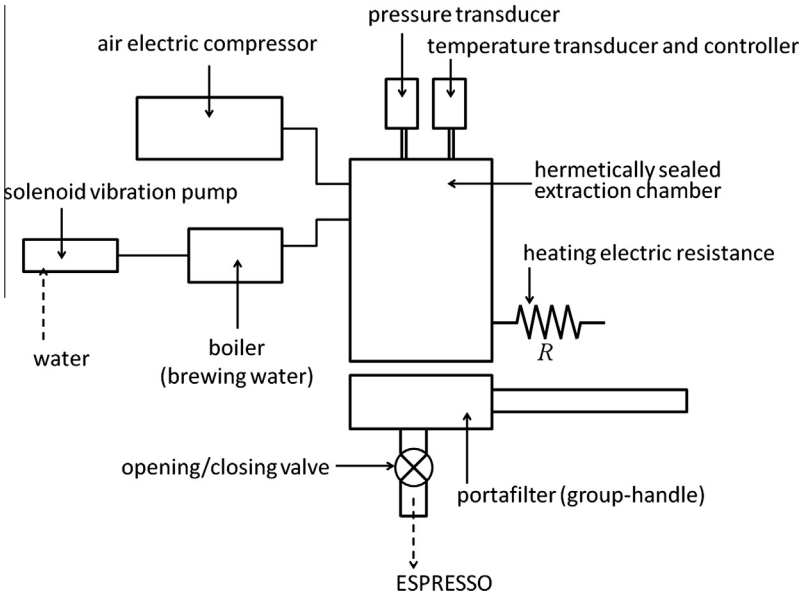

Fig. 1. Schematic representation of the Caffè Firenze brewing device.