Food Research International 42 (2009) 727–732

Contents lists available at ScienceDirect

Food Research International

journal homepage: www.elsevier.com/locate/foodres

Espresso coffee (EC) by POD: Study of thermal profile during extraction process and influence of water temperature on chemical–physical and sensorial properties

D. Albanese [a], M. Di Matteo [a,*], M. Poiana [b], S. Spagnamusso [c]

[a] Department of Chemical and Food Engineering, University of Salerno, Via Ponte Don Melillo, 84084 Fisciano (SA), Italy
[b] Department of Biotechnologies for Agricultural Food and Environmental Monitoring, University of Reggio Calabria, Feo di Vito 89060 (RC), Italy
[c] Department of Food Science, University of Naples "Federico II", Via Università 100, 80055 Portici (NA), Italy

ARTICLE INFO

Article history:
Received 10 December 2008
Accepted 22 February 2009

Keywords:
Espresso coffee
Profile temperature
Extraction temperature

ABSTRACT

In this work the thermal profiles of five coffee pods (pure Arabica, pure Robusta, and Arabica Robusta blends: A20R80, A80R20, and A40R60) at 90, 100 and 110 °C are reported. Moreover the chemical–physical and sensorial properties of espresso coffee (EC) obtained from five different coffee pods were investigated. The analysis of the thermal profiles highlighted that the extraction process can be considered as an isothermal process because, after a starting phase, the recorded temperatures stayed around a mean temperature (T_m). In addition the T_m recorded for each extraction temperature was significantly lower than those set up by the controller. The chemical–physical parameters of EC samples increased proportionally with extraction temperature highlighting that the effectiveness of extraction process scales up with percolation temperature. The solid and caffeine contents of the EC samples extracted at 110 °C are related to an over extraction process. Principal Component Analysis (PCA) was applied to identify relationships and differences among EC samples. Pure Arabica and A80R20 EC samples at 100 and 110 °C have shown sensorial attributes typical for a fine espresso coffee.

© 2009 Elsevier Ltd. All rights reserved.

1. Introduction

Espresso coffee is a typical Italian beverage obtained by a percolation process of hot water under pressure through compacted and ground coffee beans. Normally the brew is produced by professional machines and after specific operations made by expert hands that have the aim to define the quality and quantity, degree of grinding and compression of coffee in order to obtain a cup of espresso with specific sensorial properties.

An EC of a good quality, in fact, should have specific sensory attributes related to visual aspect, taste and aroma. A good espresso coffee should have a balanced bitter/acid taste, a strong body, a potent and fine aroma, and a persistence hazelnut foam with a texture very compact. The presence and the intensity of each specific sensorial descriptor in a cup of espresso coffee is influenced by the botanical origin and roasting degree of the coffee, but the result is strongly affected by the physical condition that controls the percolation process (grinding grade, temperature and pressure of the water, and percolation time). All these variables influence the amount and the type of substances that are extracted during the percolation process under hot water conditioning the chemical, physical and sensorial properties of the EC (Andueza et al., 2003; Andueza et al., 2002; Andueza, de Peña, & Cid, 2003; Illy & Viani 1995; Nunes & Coimbra 1998). Inside an espresso coffee cup it is possible to find two types of substances that can be classified as soluble and emulsifiable compounds. The soluble class includes volatile substances such as pyrazynes, aldehydes, ketones which are responsible for the aroma (not volatile substances such as caffeine, acids, sugar responsible for the taste of the EC (Buffo & Cardelli-Freire, 2004) whereas the emulsifiable compounds include proteins, lipids, polysaccharides and melanoidines that affect the body and the foam of the brew (Nunes, Coimbra, Duarte, & Delgadillo, 1997; Petracco et al., 1999). Moreover the presence of the foam on the top of the brew is a typical characteristic of the EC absent in other kinds of coffee brew. To obtain a proper extraction of all these substances for the preparation of an espresso coffee cup of quality it is important that the percolation process of water through the bed of ground coffee takes place at specific temperature. Studies about the influence of the inlet water temperature on chemical–physical and sensorial properties of EC are reported by Andueza, Maeztu, et al. (2003) while the water temperature suggested by Illy and Viani (1995) and International Institute of Coffee Tasters (Odello & Odello, 2002) is proximate to 90 °C. All these results concern espresso coffee prepared with the traditional method that includes the use of professional machines after the filling and tamping the ground coffee in the filter holder, but there are no scientific works that study the influence of technical condition parameters (variety of coffee beans, grinding grade, percolation time, and water temperature) on final quality of espresso

* Corresponding author. Tel./fax: +39 089964131.
E-mail address: mdimatteo@unisa.it (M. Di Matteo).

0963-9969/$ - see front matter © 2009 Elsevier Ltd. All rights reserved.
doi:10.1016/j.foodres.2009.02.027

coffee by pod. The espresso coffee by pod uses a simple technology that includes the usage of a specific espresso coffee machine and individual pre-packed doses containing pre-measured, and pre-tamped ground coffee. Ground coffee is hermetically sealed between two fine layers of filter paper, in aluminium or plastic capsules. This method to drink espresso coffee has revolutionized the coffee market that registers actually pod sales equal to 10 milliards of euro/year (Tozzi, 2007). The key point of this success is to allow anyone, expert or non expert, to prepare it any time and in all those places (home, train, office, and airplane) where the limited amounts consumed do not justify or allow the use of professional machines.

The aim of this work was to investigate the influence of extraction temperature and the coffee botanical variety on physical chemical and sensorial properties of espresso coffee by pod to optimize and standardize its quality. Moreover the thermal profile set up inside the whole pod during the percolation process was investigated too.

2. Materials and methods

2.1. Materials

Five different coffee roasted pod samples, pure Arabica from *Coffea Arabica* (A), pure Robusta from *Coffea canephora* (R), and Arabica Robusta blends at three different percentage (A20:R80, A80:R20, and A40:R60) were provided by a local company. The coffee pods were produced according to ESE (Easy Serving Espresso) standard that consists of individual pre-packed doses, containing 7 g of ground coffee that has been pressed and hermetically sealed between two fine layers of filter paper.

In order to isolate the effect of the extraction temperature and of the coffee botanical variety on espresso coffee quality, the preparation of the five different coffee pod samples was made using a unique roasting grade for both cultivars (Arabica and Robusta). The influence of grinding grade on the quality of the brew was deleted by means of the selection of grinding grade able to produce 25 ml of espresso coffee samples at a percolation time ranging from 23 to 26 s. All the coffee pod samples have shown to have a bimodal particle size distribution, with two similar bells ranging from 80–350 μm to 400–800 μm, respectively (data not reported).

2.2. Preparation of EC for the chemical and physical analysis

ECs were prepared using an experimental espresso coffee maker. The experimental espresso coffee maker has been modified with Digital Temperature Controller (Omron model E5CN, Kyoto, Japan) and solid state timer (Omron mod H3CR, Kyoto, Japan) in order to set the extraction temperature and the percolation time, respectively. For the preparation of EC samples were used a volume equal to 25 ml, water pressure fixed at 12 atm, a percolation time ranging from 23 to 26 s, while the investigated water output temperatures were 90, 100, and 110 °C. A total amount of 45 espresso coffee samples (five coffee pod samples for three temperatures by three replicates) were prepared for the analysis. The chemical–physical results were expressed as a mean of three replicates.

2.3. Temperature profiles

The temperature profiles established inside coffee pod samples during extraction process were investigated during the time ranging from 10 to 30 s, with $\Delta t = 5$ s. Temperature profiles registered by SCB-68 68-Pin Shielded Connector Block (National Instruments Corporated) linked to five thermocouples K type (Ø = 0.5 mm) located on and in the coffee pod samples (Fig. 1) are as follows:

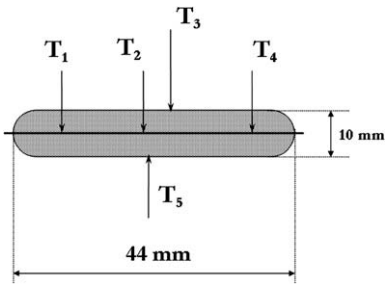

Fig. 1. Type *K* thermocouples location.

T_3 located in the middle of the superior surface of coffee pod sample; T_1, T_2, and T_4 disposed in the median plane of the wafer (T_2 in the core of coffee pod, T_1 and T_4 in the diametrically opposite peripheral points); T_5 located in the middle of inferior surface of coffee pod.

2.4. Analyses

pH was determined using an electronic pH meter (Crison, model Micro pH 2002, SA, Barcelona, Spain).

The foam index was defined as the ratio (%) of EC foam and liquid volumes measured immediately after the extraction process. The persistence of foam was defined as the time necessary to start open areas of liquid on the surface of the foam during cooling at room temperature. Stable foam is achieved when its texture is very compact, and it does not tend to form open areas through which the liquid underneath can be seen. The titratable acidity (TA) was calculated according to Nicoli, Dalla Rosa, and Lerici (1987).

Total solids were calculated by oven drying 25 ml of EC at 100 °C until a constant weight (18 h at 100 °C). Extraction was defined as the percentage of total solids with respect to ground roasted coffee dose (7.0 g).

Caffeine content was calculated by UV spectrometric method. EC samples (10 ml) were put in separating funnels and an equal amount of chloroform was added to each sample. The separating funnel was shaken vigorously for 5 min and the solutions could separate after 10 min at room temperature. 500 μl of the chloroform layer collected from separating funnel, was diluted 10 times with pure chloroform and was used for analysis. Absorbance of these solutions was measured at 276 nm (i.e. at predetermined λ max) by a Perkin–Elmer lambda-Bio 40. A standard curve of caffeine content was prepared in the range between 0.1 and 0.8 mg/ml.

2.5. Sensory descriptive analysis

The sensory properties of the EC samples were measured using a variation of the quantitative descriptive analysis (QDA) method. The judges were chosen among members of the Engineering Faculty of the University of Salerno using as selection criteria time availability, no aversion to coffee. The preselected judges were submitted to preliminary tests to investigate the ability to identify odours and the five basic tastes, using ISO 3972:1991 and ISO 5496:2006 in order to recruit 10 judges. The descriptors chosen for the quantitative descriptive analysis of the different espresso coffee samples were eight parameters that included visual objective, gustative/tactile and olfactive evaluation (Odello & Odello, 2002). The parameters taken into consideration were body, acid, bitter, astringent, roast intensity, olfactive intensity, texture, and colour intensity, rated on 9-point scales from "none" (1) to high" (9).

Download English Version:

https://daneshyari.com/en/article/4562846

Download Persian Version:

https://daneshyari.com/article/4562846

Daneshyari.com