
ESPRESSO (COFFEE)

THE CHEMISTRY OF QUALITY

EDITED BY

Andrea Illy and Rinantonio Viani



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Preface

Although originally an Italian product, the popularity of espresso has spread, especially in European countries of Latin origin and in recent years it has been on the increase in other markets too, above, all in the USA and Japan. Its success lies in the greater satisfaction it gives to the consumer when compared with coffees prepared by other methods.

Espresso is therefore the way of preparing coffee that offers higher quality to consumers. But without strict adherence to the issue of quality, espresso will lose this appeal. In fact, if consumers cannot drink high quality espresso, they will sooner or later get weary of it.

It is not easy to obtain a quality espresso; its very strength, the ability to concentrate aromas, is also its weak point because while enhancing the qualities, it shows up the defects of the raw material at the same time. Even the preparation of coffee, which doesn't allow for mistakes, gives good results only if it is carried out under the best conditions.

The road to quality espresso is therefore long and arduous. The result is that far, too often manufacturers don't maintain high standards try and therefore the espresso served to consumers is often second rate.

Juran once said "you can't have quality if you can't measure it". So, if we really want to offer our consumers the quality they are looking for, it is necessary to make clear what we mean by espresso *quality*. We must therefore establish what factors contribute to quality and then develop methods to control it.

The preface serves to explain our objective in writing this work, which is intended as the first piece in the mosaic of knowledge needed for the making of "quality espresso". Our aim is to raise the average quality of espresso served to consumers so greatly that it will become the most widespread method of preparation in the world.

Chemistry plays an important role in the study of espresso quality, both for the identification and analysis of the causes of bad quality and for the controlling of the different production stages. Thus, the book deals specifically with "chemistry of quality".

The topics of the book are organized according to a top down approach: in the first two chapters, we wish to clarify all points which regard the work, meaning quality and espresso. In the remaining chapters the chemical, chemical-physical and chemical-biological factors that weigh upon the quality of espresso are described, following the long chain of successive processing, that goes from the selection of the coffee plant to cultivate to the cup of espresso. Thus, chapter 3 regards the influence of the coffee plant and the agronomic conditions, chapter 4 all the processing which can be made to the green coffee and chapter 5 the roasting. Chapter 6 looks at the grinding, chapter 7 the packaging, which is a necessary study in the case because most often in this stage between the roasting and the consumption, a certain period of time passes. In chapter 8 the preparation of espresso is described from the roasted coffee stage. Chapter 9 concludes the processing, supplying a scientific definition of espresso based on the concepts discussed in the previous chapters. Finally chapter 10 is a series of analytical methods to assure quality.

The topics dealt with in the text are those which are at present described in professional literature or in agronomic and industrial practice. It is for this reason that, where information on these subjects is insufficient or fragmentary, the text too is incomplete. The level of detail gives an understanding of the phenomena presented and has, as far as possible, been kept homogeneous throughout all chapters.

As a study of chemistry, more emphasis is placed on these topics, while topics connected with other subjects such as, botany, agronomy and technology are introduced only where they are pertinent to the quality of espresso.

In keeping with the structure of the book, basic notions on coffee or chemistry have not been introduced. For these the reader can refer to more general manuals. Technical terms have been avoided (wherever possible) so as to make the book more accessible to the layman.

The principle chemical substances (or classes of substances) are in the same order with the same numeration in the various chapters.

The bibliography at the end of the book is exceptionally large and represents the true patrimony of this work.

Foreword

The unpredictability of the international coffee market and fluctuation in coffee prices over recent years has meant that producers have been barely able to cover their production costs, with the worst affected markets being those for low-quality coffees.

The gourmet coffee and espresso sectors have consistently been the fastest-growing of the international coffee markets, although this potential has only been realised by a few coffee-producing countries. Such quality coffees may either be sold as single-origin speciality products or as high-grade traditional blends. Entry into this market requires product development in terms of product selection, presentation and marketing.

The strategic importance of this area has prompted the International Coffee Organisation to stimulate the consumption of quality coffee and more recently the production of gourmet coffee.

Improving quality control at all stages of production and preparation is seen as the primary vehicle of change, which involves a great deal of scientific and technical knowledge. This body of knowledge is spread throughout the scientific literature, making research a time-consuming business!

Espresso Coffee: the chemistry of quality has been written to provide readers with a comprehensive resource for those interested in the fundamental notions of coffee quality. This book will become the first point of reference for the world coffee community, with the detailed bibliography directing the reader to the wider literature.

I hope that such dedication to quality will be echoed in the coffee-producing community and that the resultant increase in coffee standards will increase both the size of the markets and the quality of the products.

PF Beltrao

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1 Definition of Quality

Quality has many facets and a definition focusing only on certain specific attributes may miss important aspects. It has recently been defined as *the **totality** of features and characteristics of a product or service that bears on its ability to satisfy stated or implied needs* (ISO 8402-1986).

1.1 COMMERCIAL QUALITY

Globalisation of trade, accelerated since 1945, has stimulated the awareness of quality management in industrial production, which is now formalised into a science particularly in the USA and Japan. Feigenbaum (1956) expressed this concept with a basic statement, which is still valid: *Total quality control must start with the design of the product and end only when the product has been placed in the hands of the customer who remains satisfied.* This emphasises the need for quality throughout the whole development, production and distribution sequence. Juran (1988) identified the components of quality as quality of design, conformity to specifications, availability and field service.

From a consumer's perspective various aspects of quality may be distinguished at increasing levels:

1. Expected quality – the consumer's expectations from a particular product.
2. Induced quality – the consumer's expectations from a particular brand, based on prior experience.
3. Effective quality – the level of service or characteristics which the product provides, such as performance, composition, or environmental impact.
4. Overall quality – the sum of induced and effective qualities, which may vary from unacceptable to greater than expected.

5. Potential quality – a measure of possible future increments in quality.

Once consumers have decided to try a product (expected quality), they will then choose a brand based on its perceived quality (induced quality). They will then assess its effective quality in relation to the induced quality, which will influence subsequent purchasing decisions. Psychological interactions between these aspects of quality may distort the consumer's final evaluation, and a product with a high induced quality may not be immediately recognised as having a low effective quality, even when in reality it is an extremely poor quality product.

1.2 QUALITY CERTIFICATION

In order to allow free trade, there is a need for some form of quality standardisation with associated certification. This may be one of two types either relating to the product conformity or to the relevant quality system.

Conformity simply refers to agreement with a declared specification or composition. It may be compulsory in some instances, such as technical standards, or the producer may use it as an indication of quality.

Quality system certification refers to the 'quality assurance system' and covers all the factors which the producer uses to ensure the quality standard of products. This is a more indirect assessment of quality, but is becoming more prevalent in Europe and elsewhere in standards such as ISO 9000 (1991).

1.3 QUALITY OF FOOD PRODUCTS

With most foods quality means first of all nutritive value, contributing to a balanced diet composed of proteins, carbohydrates, lipids, minerals and vitamins, essential for health and well-being; it also concerns wholesomeness, viz.,

the absence of both chemical and microbiological contaminants.

The sensory characteristics of a food product are, however, more important than its nutrient value for its perceived quality. Thus, attributes like colour, aroma and texture play a major role in the acquisition process. Convenience, such as special packaging, storability, and ease of preparation also influences in the perceived quality, sometimes even in conflict with sensory or nutritional qualities.

1.4 QUALITY OF ESPRESSO COFFEE

Coffee, stimulation for the mind, is in a special position: what people look for in it is not nutrition; on the contrary, it is appreciated for its lack of calories. Coffee appeals to people for its special flavour; the intake of small quantities of the mild stimulant, caffeine, it contains, may also play a (minor) role. The mode of preparation and presentation, its appearance and mouthfeel, its *body*, are as important in the appreciation of espresso as aroma and taste.

2 Definition of Espresso

Everyone in Italy has a clear mental picture of a cup of espresso: a small heavy china cup with a capacity just over 50 ml, half full of a dark brew topped by a thick reddish-brown foam of tiny bubbles. More than 50 million cups of espresso are consumed every day in the world: its fragrance and flavour are the first stimuli in the morning, they crown an excellent meal later in the day, and act as frequent revivifiers during lengthy working sessions.

2.1 ESPRESSO AS A LIFESTYLE: BREWED ON THE SPUR OF THE MOMENT

One of the meanings of the word *espresso* (express) is that it is made for a special purpose, on the moment, on order (Marzullo, 1965; Hazon, 1981), therefore made for the occasion on express request, extemporaneously rather than fast. This concept is clarified by the saying 'the consumer not the espresso must wait'. As a direct consequence, once brewed, espresso cannot be kept, and must be drunk just after having been served. If it is not drunk immediately, the foam shrinks and collapses, breaking into patches on the surface. After a while, the surface of the liquid is completely free from foam, which has dried out on the walls of the cup above the liquid.

If an espresso is kept waiting, smoothness of taste is lost and perceived acidity increases with time regardless of cooling. Furthermore, if the cup cools down, an unbalanced saltiness becomes noticeable.

- Freshness of preparation must be an integral part of the definition of this very special brew.

2.2 ESPRESSO AS A BREWING TECHNIQUE: IT REQUIRES PRESSURE

At the beginning of this century the need for preparing a cup of coffee within seconds of a customer's request led to an increase in the pressure of the extraction water. Water was heated up to its boiling point in a sealed kettle, so that the steam in equilibrium created pressure, accelerating extraction. A draw-back of this technique was that brewing with boiling water provokes over-extraction of astringent and bitter usually less soluble substances, which give a *burnt* taste to the brew.

Brewing was first improved by separating the water used for brewing, best hot but not boiling, from the heating water. Pressures as high as 10 bars could be created by a lever, multiplying the force of the arm of the bartender, producing a thick layer of foam on the cup. The lever has now been replaced by an electric pump, simpler and more regular to operate.

A pressure field applied within a fluid produces potential energy – what is known as Bernoulli's piezometric energy – which can be easily transformed into kinetic energy, and further transformed into surface potential energy and heat. Pressure is important for the definition of espresso, making it different from other brews. During espresso percolation (see Chapters 8 and 9), a small amount of hot water under pressure is applied to a layer of ground roasted coffee, the *coffee cake*, and this very efficiently produces a concentrated brew, containing not only soluble solids, but also lipophilic substances, lacking in all other brews. The foam on the top and the opaque brew are unique to espresso, owing to the presence of a disperse phase formed by very small oil droplets in emulsion (Petracco, 1989) (see sections 8.2 and 9.1), which are perceived in the mouth as a special creamy sensation, the *body*. Furthermore, the oil droplets preserve many volatile aromatic components, which would otherwise either escape into the atmosphere or be destroyed by contact with water as in other brewing techniques, so that the rich coffee taste lingers in the mouth for several minutes.

If coffee were percolated under high static pressure only,