COFFEE

Volume 5
RELATED BEVERAGES

Edited by
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and
R. Macrae

ELSEVIER APPLIED SCIENCE

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COFFEE

Volume 1: Chemistry
Volume 2: Technology
Volume 3: Physiology
Volume 4: Agronomy
Volume 5: Related Beverages
Volume 6: Commercial and Technico-Legal Aspects

Dedicated to the life and work
of Professor Zdzislaw Pazola

Preface

In this series of volumes on various aspects of coffee, now already covering chemistry (Volume 1), technology (2), physiology (3) and agronomy (4), the General Editors consider that there is a place for a volume on beverages related to coffee. Those beverages owe their relation to coffee in that they are derived by roasting various plant materials (seeds and roots) so that aqueous infusions or brews with hot water have coffee-like characteristics. The similarity in these roasted products arises, in some poorly defined manner, from the similarity in composition of the products prior to roasting. Thus, they all contain free amino acids and proteins, and sugars and polysaccharides, which interact and/or are degraded during roasting. In addition the individual products contain other components that are involved in flavour formation, for example trigonelline in coffee. The chemistry of flavour and colour development in coffee has been extensively studied, but is still poorly understood. The situation is no less complex in coffee-related substances, though they have received less attention. Tea is not similarly related, and cocoa, though lightly roasted, is really a by-product of chocolate manufacture.

Some of these beverages have been consumed in Western Europe and elsewhere, particularly from roasted chicory roots, for almost as long as coffee itself; whereas others, such as roasted cereals, came into prominence in the late 18th century, especially in Europe during the Napoleonic Wars, when imports of coffee beans were impeded by the British. Although these beverages have been treated as beverages in their own right, with characteristic sensory and other attributes, they have generally been and still are regarded as substitutes or surrogates for coffee. This is especially

true in times of restricted supplies (the First and Second World Wars) or of temporarily very high cost of coffee (1975–1977). In general, such roasted plant materials have also always been cheaper than coffee, and none of them contains caffeine as a stimulant; this lack of caffeine is itself an advantage to particular consumer groups (for example the Mormons in the USA). Some products, such as chicory, have also been attributed with other physiological and flavour benefits.

These roasted plant materials have a fascinating history, as indicated in Chapter 1, which also deals with the general nature of the extremely wide range of such beverages that have been manufactured and consumed at different times. Chapter 2 deals with the chemistry of raw, dried and roasted chicory, the most important of these beverages, and Chapter 7 with the agronomy of its cultivation as a field root. Chapters 3 and 4 cover the chemistry of cereal-based, and other non-cereal-based beverages. Chapter 5 deals with the manufacture of chicory and other beverages and in particular its manufacture, like instant coffee, into soluble or instant powder forms. By and large, the chemistry (and the detailed investigation of composition of both volatile and non-volatile components) of all these roasted plant materials has not received the same extensive and sophisticated treatment as has coffee (Volume 1), though analytical methods are available. The detection of these roasted plant materials in roast and ground coffee (and instant), which unfortunately have been added at various times without declaration to the consumer, still remains a problem. This subject is covered in Chapter 6. The physiological effects of the consumption of chicory have similarly not received the same detailed scientific study as compared with coffee. However, chicory has been attributed with many beneficial effects, and a personal review of these and other aspects of chicory is presented in the final chapter.

The General Editors therefore hope that this volume, perhaps the first of its kind in the English language, will provide a readable account of the overall subject by the various international experts who have contributed.

During the final stages of the preparation of this volume the General Editors were distressed to hear of the death of Professor Zdzislaw Pazola and they would like to extend their sympathy and condolences to his family and friends. Professor Pazola established an unrivalled international reputation in the field of beverages from roasted materials and his chapters published in this book show clearly his dedication to the subject.

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Glossary of Botanical Terms

LEAVES AND FLOWERS

anthesis, period from flower opening to fruit set.
axil, the upper angle between a leaf and the stem that bears it.
axillary (adj.), growing from the axil.
blade (lamina), expanded part of the leaf, apart from the stalk.
bracts, axillant leaves of flowers.
cotyledon, the first leaf or leaves of the embryo in seed plants.
dentate (adj.), toothed (leaf margin).
epigeal (adj.), describing seed germination when the cotyledons are raised above the ground to form the first leaves of the plant.
flower, reproductive stem made up of (of which one or more parts may be absent): (1) a **calyx** (whorl) of **sepals** (leaves) forming the outer case; (2) a **corolla** (whorl) of **petals** forming the inner envelope; (3) an **androecium** of **stamens** (male organ containing **pollen** in sacs in **anther**); (4) a **gynoecium** of **carpels** with **pistils** (female organ, comprising **ovary**, **style** and **stigma**).
hispid (adj.), covered with rough or stiff hairs.
inflorescence, flowering; arrangement of flowers of a plant in relation to axis and to each other.
internode, leafless interval between successive nodes.
lanceolate (adj.), narrow and tapering at both ends (leaf shape).
loculus, any cavity within which specialised organs can develop, e.g. ovules in an ovary, or pollen grains in an anther.
margins, outer edges of leaf.

node, point on the stem from which leaves, fruit buds or flowers arise.
ovule, female gamete which develops into the seed after fertilisation (in seed-bearing plants).
pedicel, the stalk attaching individual flowers to the main axis (**peduncle**) of the inflorescence.
petiole, leaf stalk.
placenta, tissue by which ovules are attached to the maternal tissue.
placentation, pattern of attachment of ovule to the ovary wall; **parietal placentation**, where, in a compound ovary, attachment is either on a central axis or on a wall along the junction of the carpels.
rosette plant, any plant with its leaves radiating outwards from a short stem at soil level.
stipule, small leaf-like appendage to a leaf, usually at the base of the leaf stem.
stomata, tiny pores in the epidermis (outer cell layer) of plants, notably of leaves, through which respiration takes place.
tomentose (adj.), densely covered with short hairs (leaf surface).
veins, ribs of leaves (thus **venation**, the arrangement of veins in the leaf blade).

FRUITS AND ROOTS

achene, simple one-seeded indehiscent fruit developed from a monocarpellary ovary.
cherry or berry, the entire fruit (botanically, for coffee, a **drupe**).
cortex, tissue between the epidermis and the stele in a root or stem.
parenchyma, a form of undifferentiated tissue.
pericarp, wall of fruit developed from the maturing ovary wall. In fleshy fruit, usually has three layers, the exocarp, mesocarp and endocarp.
root, underground part of a plant.
seed, structure that develops from the fertilised ovule in seed plants, and subsequently the reproductive unit.
stele, the central core of the stems and roots of vascular plants.

Contents

Chapter 1

Introduction

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1. GENERAL

The use of coffee is now world-wide. Its high level of consumption is due to the fact that coffee nowadays is comparatively low-priced and readily obtainable. This has not always been the case. Therefore, substitutes for coffee have been prepared from many other plants, mainly from their seeds and roots, which, like coffee beans, contain large amounts of carbohydrates, appreciable amounts of protein, and sometimes other compounds with physiological activity, but rarely caffeine. On roasting, these seeds and roots generally tend to take on a coffee-like colour and give a high percentage of water-soluble extract, which sometimes has a flavour similar to that of coffee. It is believed that coffee-like soups, porridges and beverages from these seeds and roots had been used before coffee became known in Europe.[1] In the year 1592 Prosperus Alpinus of Padua described the recently available coffee beverage as most similar to the infusion from chicory, which implies that the latter must have been previously used as a beverage. Cereals and chickpeas especially may have been used in this way too, but nothing has been recorded. Nevertheless, coffee substitutes gained no real importance prior to the 18th century. The first to be used to a large extent was chicory, followed by barley and rye. Some countries, such as Prussia, favoured the cultivation of suitable plants in order to save foreign exchange. A boom in production and consumption in the European continent was caused by the Continental System of Napoleon I and by the two World Wars. In 1806, Laubender had already described 42 different

Table 1
Per capita consumption of coffee substitutes and coffee beverages in Germany (until 1938) and West Germany (litres per year)

Year	*Coffee substitutes*	*Coffee*
1913	194	40
1938	240	44
1966	27	127
1983	9	170

coffee substitutes.[2] Later on, more than 100 raw materials and roasted products had been tested,[3] but of these, besides chicory and the cereals mentioned, only malted barley (since the end of the 19th century) and figs (since the beginning of the 19th century) have gained importance. Often they have been used together with coffee as coffee additives, especially chicory, and, from the end of the 18th century to the middle of the 20th, together with caramelisation products of sugars or molasses.[1] Since the middle of this century, commercial blends of substitutes have predominantly been consumed, at least in Germany. Nowadays aqueous extracts of coffee substitute (liquid but more usually dried) are often used.

Little is known about the production levels and the quantities of coffee substitutes consumed (for chicory see section 2.1). However, a few statistical figures for Germany are available. In 1913, the coffee substitutes consumed were made up of 34% malt coffee, 31% chicory and sugar-beet coffee, 18% barley coffee, 12% rye coffee, 2% caramel, and 1% each fig coffee, wheat coffee and oak-seed (acorn) coffee.[3] The whole production amounted to 194 500 t. In 1938, the corresponding production was 250 000 t, and in 1966 for West Germany 24 000 t. The *per capita* consumption of coffee substitutes and also of coffee for a few years is shown in Table 1.[1,3,4]

In the following sections, a general survey of the individual substitutes will be given in their historical context, and in respect of their botany, composition and properties.

2. COFFEE SUBSTITUTES CURRENTLY PRODUCED COMMERCIALLY

2.1. Chicory

2.1.1. History

Chicory as a coffee substitute is the root of *Cichorium intybus* L. var. *sativum* DC. This plant is descended from the wild chicory (wild succory,