SHORT COMMUNICATION

Evidence of Spice Black Pepper Adulteration

BOHUSLAVA TREMLOVÁ

University of Veterinary and Pharmaceutical Science – Department of Meat Hygiene and Technology, Brno, Czech Republic

Abstract

TREMLOVÁ B. (2001): **Evidence of spice black pepper adulteration**. Czech J. Food Sci., **19**: 235–239.

The goal of this work was to verify the spice adulteration by the microscopic analysis. The samples of black powdered pepper and its meat product that did not have the expected spice and aromatic properties were controlled. The results of sensory and chemical investigation corresponded with microscopic findings. The suspected sample of spice and meat product with spice contained pronounced coloured parts that were not present in the usual structure of powdered pepper.

Keywords: microscopic methods; spice; pepper; control

Problems with foodstuffs vary with stages of history, from continent to continent and from one country to another. The problem of food and raw material adulteration has always occurred and the consumer protection played an important role of the control. Foodstuffs and processing of raw food were exposed to adulteration to a smaller or greater extent since long time ago. Many cases of bread, wine, beer, spice and valuable natural coloured materials, later coffee, tea, alcoholic beverages and many other adulterations of foodstuffs were described.

Intentional adulteration continues further. The frequency and quantity of these cases are under rigorous legal regulation and control, and promote development of new effective analytical methods. Methods for the detection of food adulteration are based on physical, chemical, biochemical and microscopic technologies. All these methods that formerly substituted sensory and other empirical assays are still being improved because food adulteration continues in a new form. Microscopic analyses of foodstuffs and food raw materials of plant origin have had a long history. Microscopic analyses made it possible to distinguish between coffee and chicory as early as in 1850 (FLINT 1994).

Besides chicory, it was possible to identify roast wheat, bean, seed of lupine and other substances. Measurement of some particles served for food identification – e.g. height of palisade cells in pulses. The first atlas of "vegetable foodstuffs" came out in 1904 (FLINT 1994). Diagnosis of foodstuffs and raw food of plant origin can be established, for example publications by GASSNER *et al.* (1989).

MATERIALS AND METHODS

***Investigated Samples**:* Black powdered pepper (suspected sample of food adulteration and control sample); meat product with suspected sample.

Spice samples were subjected to sensory evaluation (appearance, colour, smell) pursuant to Regulation No. 331/1997 of the Ministry of Agriculture. The mineral substances were determined chemically using a simple chloroform method (KAVINA 1997). Samples of spice and meat product with spice were prepared for microscopic analyses. These samples were stained using a current staining method (haematoxylin-eosin) and checked under the light microscope. For comparative diagnosis of individual parts

of the samples schematic drawings and standard preparations with spice as well as findings from other investigations of meat products were used. The results were documented.

Microscopic Structure of Spice (Figs. 1 and 2): The coat of black pepper consists of tiny cells with brown content covered by the cuticle with a few stomata. Below the coat there is a layer of thick massive lignified and sclerenchymatous cells with yellow walls and brown content. The layer under sclerenchymatous cells creates the basic parenchyma (mesocarp) that consists of tangentially elongated cells with small starch seeds. Between these tangentially elongated cells are scattered secretory cells in the shape of egg with the corky cell wall containing essential oil and resin.

The inner layer of the basic parenchyma contains groups of vessels with spiral and massive cells and elongated sclerenchymatous cells.

Below the vessel groups the mesocarp passes into the rigid parenchyma with an abundance of secretory cells. The other layer below is created by one range of sclerenchymatous cells that are highly massive and lignifed on the inner side; on the transverse side they have a horseshoe shape. This is the important characteristic of pepper determination.

The episperm is formed by three parts – the outer part has a yellow band, in the middle is a pigment layer and the inner part contains colourless and swollen cells. The main tissue of the seed consists of small cells with aleuronic seeds on the periphery; the remaining structure has big, radially elongated, thin-wall cells with small starch seeds (GASSNER *et al.* 1989).

Powdered spice contains fragments of the above-mentioned tissue and is usually well identified in meat products too (Figs. 3 and 4).

The results of sensory evaluation of powdered spice are shown in Table 1.

Black coloured elements that did not correspond with the common structure of powdered pepper were found by microscopic analyses of the suspected sample with black powdered pepper (Figs. 5 and 6) as well as meat product with pepper (Fig. 7). No similar substances were detected in the control sample. Chemical analyses confirmed parti-

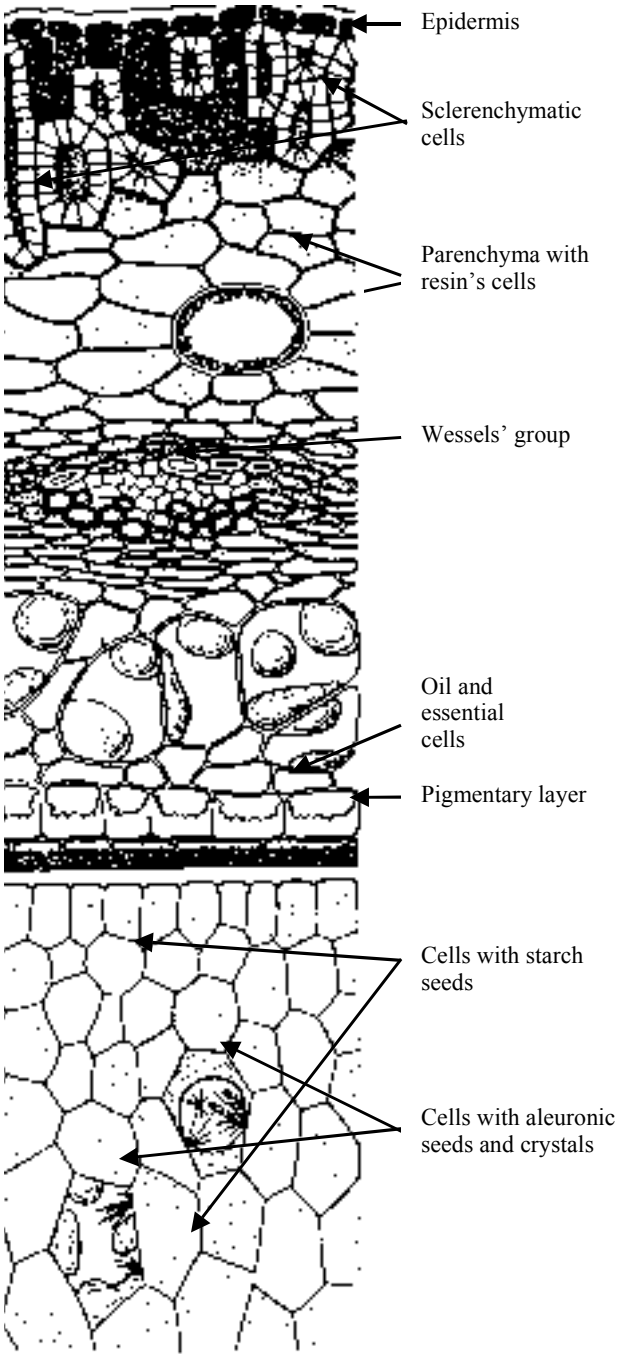
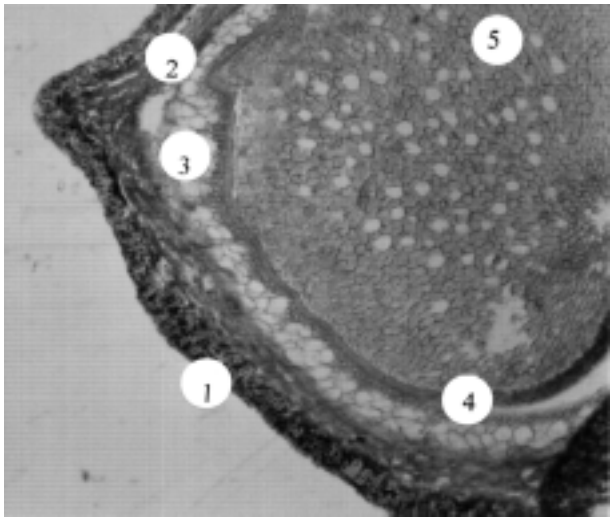
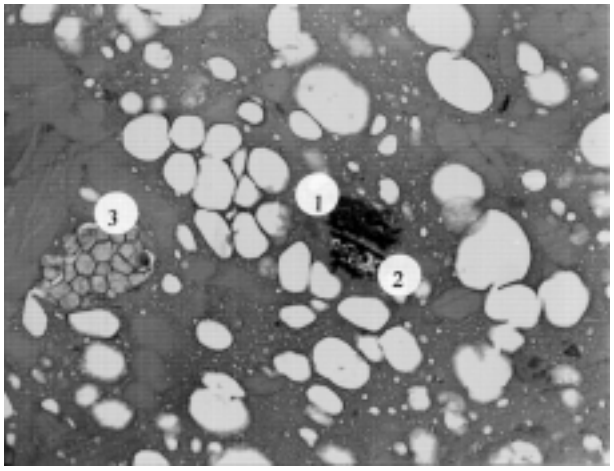


Fig. 1. Black pepper – fruit structure

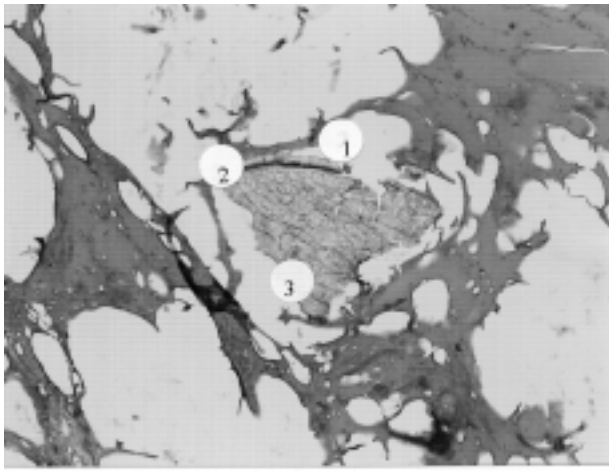


1 – sclerenchymatous cells; 2 – parenchyma with resin' cells; 3 – oil and essential oil cells; 4 – pigment layer; 5 – cells with starch granules

Fig. 2. Black pepper (the whole spice)

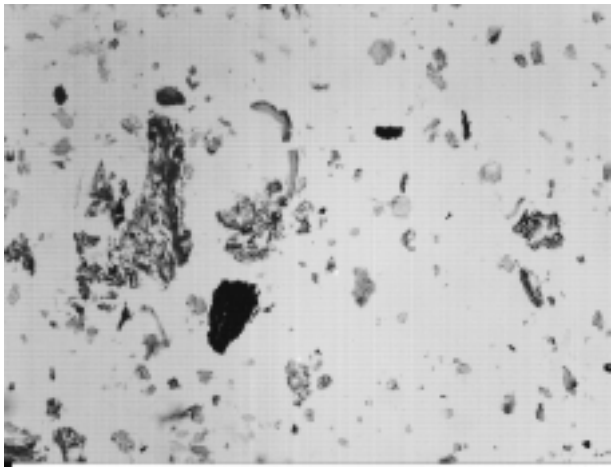


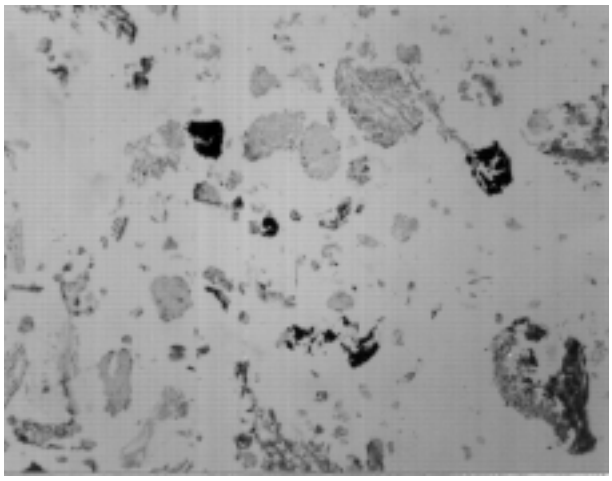
1– epidermis; 2 – sclerenchymatous cells; 3 – cells with starch granules



1– layer of horseshoe cells; 2 – pigmented layer; 3 – cells with starch granules

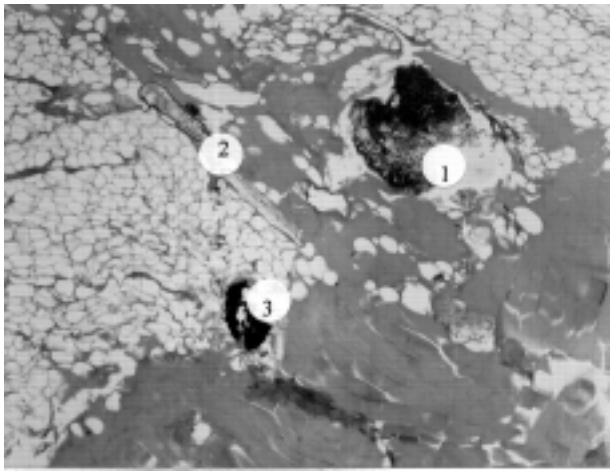
Figs 3. Powdered black pepper (sausage)





foreign particles – black coloured corpuscles

Fig. 4. Powdered black pepper (suspected sample)



1– black pepper; 2 – red pepper; 3 – foreign particle
foreign particles – black coloured corpuscles

Fig. 5. Sausage (with suspected pepper) Haematoxylin-eosin, magnification 40 ×

Table 1. Sensory evaluation of spice samples

Evaluated characteristics	Black powdered pepper	
	suspected sample	control sample
Appearance	coarse powder, large particles	fine powder, small particles
Colour	dark brown dark colour particles prevail	grey-yellow with dark (brown) particles
Smell	empty, little spicy	typical of pepper – hot

cles of mineral origin (in contrast to plant corpuscle mineral sediment) in the suspected sample.

DISCUSSION

The term "spice" usually represents dry or alternatively processed parts of plants that give foodstuffs particular taste and aroma. These properties are due to essential oil contents that determine food quality. The quality of spice is influenced by plant origin, cultural practices, harvest date, treatment and storage conditions.

The extraction of essential oil is one of the possibilities of intentional adulteration of natural spice. The addition of an extraneous matter to powdered spice not being seen at first sight often adulterates the powdered spice (ARCHER 1987).

Black pepper is the final dried product of immature berries of *Piper nigrum*. Pungent taste is conferred to pepper by the alcaloid piperine and resin, which are mainly in the seed capsule; spicy smell is caused by essential oil. The other kinds of pepper (white, red, green) are produced by different processing of the same fruits. White pepper has no network of pericarp in the band of vessel groups.

After caraway seed, pepper is the most frequently used spice. Black pepper is on the list of "Raw Material Products" almost in all types of meat products. Though pepper is not an expensive spice, its adulteration even of the whole seed – by addition of foreign berries, seeds or artificially produced pepper from wheat or leguminous flour – has often been encountered. Powdered pepper is adulterated by **pigmeal**, seed capsules of various fruits, stones, kernels, flowers, minerals and the waste material of pepper production (CURL & FENDWICK 1983). Regulation No. 331/1997 does not lay down the standard of fine powdered pepper and the coarse structure is not a reason for negative assessment. Smell control must take into account previous manipulation with the spice because the essential oil can volatilize as a result of unsuitable storage conditions. The purity and kind of pepper are determined above all by the microscopic analysis. It is possible to identify extraneous matters of organic (plant parts, insect, faeces) and inorganic origin. Chemical analyses should determine moisture content, ash, cellulose, starch including piperine and pigmented corpuscles. To obtain preliminary results of corpuscles of inorganic origin chloroform will serve as a proof (KAVINA 1997). Regulation No. 331/1997 does not permit any adulterants in black pepper.

Microscopic analyses are currently used for herb, spice, flower and honey identification. Standard microscopic techniques are easy to perform but investigation and evaluation require experience and possibility of comparison with the standard material.

Conclusion

Microscopic analyses revealed the suspected sample of pepper with foreign corpuscles. The same corpuscles were found in the meat product with pepper. The results of sensory evaluation and chemical analyses also contributed to identify the food adulteration. The presented sample is an evidence of classical food adulteration nowadays.

Food and raw material adulteration is a problem that the consumers and inspection authorities will continue to meet with even though the forms and possibilities are changing with the development of new technologies and new types of foodstuffs.

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Received for publication April 24, 2001
Accepted for publication October 18, 2001

Souhrn

TREMLOVÁ B. (2001): **Průkaz falšování koření černý pepř**. Czech J. Food Sci., **19**: 235–239

Mikroskopickými metodami byla určena struktura černého pepře. Získané výsledky byly použity ke stanovení míry falšování koření mletý pepř. Byly vyšetřeny jednak vzorky mletého koření a jednak masné výrobky, k jejichž okořenění byl použit černý pepř. Výsledky smyslového vyšetření korespondují s mikroskopickým nálezem.V podezřelém vzorku koření a rovněž v masném výrobku byly zjištěny výrazně zbarvené součásti, které neodpovídají obvyklým strukturám v mletém pepři.

Klíčová slova: mikroskopické metody; koření; pepř

Corresponding author:

MVDr. Bohuslava Tremlová, Ph.D., Veterinární a farmaceutická Univerzita, Fakulta veterinární hygieny a ekologie, Ústav hygieny a technologie masa, Palackého 1-3, 612 42 Brno, Česká republika

tel.: + 420 5 41 56 26 37, fax: + 420 5 41 32 12 30, e-mail: tremlovab@vfu.cz