Off-flavour Defects of Packed Waters and Soft Drinks

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Abstract: Greases and lubricants, organic cleaning agents and other material which are used for the maintenance of technological equipment belong to the important potential sources of off-flavours in packed water because of higher risk of misuse or fault of the staff. A simple, efficient and sensitive method of SPME/GC/MS together with descriptive sensory analysis have been used to analyse the sensory defect. The real case study of the consumer complaint to the PET bottled spring water was solved, the defective products exhibited the organic, petroleum, hydrocarbon taint, the complaints were about twenty bottles of one batch. Aroma profiles of all maintenance agents used in the plant were analysed, and compared with that of the suspect sample. As the most probable cause the incorrect use of anticorrosion and lubricating agent in the form of the bottle blowing machine was identified.

Keywords: off-flavour, defects, packed water, SPME, GC/MS

INTRODUCTION

One of the major causes of consumer complaints to the soft drinks industry are sensory defect, mainly an unacceptable flavor, which can originate from the incidental chemical or microbial contamination of beverage from environmental sources (e.g. raw materials, water, packaging materials, processing contaminants, flavor modification by contaminating microflora, etc.) or may arise in the beverage itself as a result of degradation of some components (e.g. aroma oxidation, non enzymatic browning, enzymatic action). The third cause of improper flavor is when the flavor is not satisfactory due to the incidental dosage error, evaporation or reaction of characterising flavor component with the beverage itself (Reineccius 1997).

Natural spring waters is more sensitive to off-flavours comparing to soft drinks which contain carbon dioxide, fruit content, plant extracts or aroma bases. Greases and lubricants, organic cleaning agents and other material which are used for the maintenance of technological equipment belong to the important potential sources of off flavours in water. Comparing with off-flavours originated from organic compounds present at low concentration levels down to the sub-part-per-trillion and of very low odour threshold such as dirty dishcloth, earthy, musty probably caused by law bacterial metabolites in water, disinfectant or medicinal off-flavours caused by chlorinated humins or iodine compounds of various oxidation stages (Saxby 1995), maintenance agents as the contaminants which caused changes in taste and odour are usually present in water in relatively higher levels (Llompart *et al*. 1998). However, the identification of their sources is also complicated in this case, as there are of different chemicals constitution and several potential sources within the production of natural spring water could be mentioned. The aim of the presented paper was to describe the procedure of real case of off-flavour identification caused by maintenance action.

MATERIAL AND METHODS

Material. Three samples of natural spring waters reclaimed for their unacceptable sensorial properties, nine samples of lubricants and solvents from maintenance shop in the producing plant, as the potential processing contaminants (description in Table 1).

Methods. HS-SPME procedure: 100 μm polydimethylsiloxane fibre (Supelco Inc., Belefonte, USA)

Table 1. Description, volatile compounds profile and odor characteristic of 9 samples of lubricants and solvents from maintenance shop in the producing plant, as the potential processing contaminants

Chemical agent	Product description	Volatile compounds profile	Spiked level (mg/l)	Odor characteristic
Mobil Pyrolube 830	lubricant for conveyor chains, synthetic, PAO/ester mix based	2-methoxyfuran, unidentified volatiles	10	strong, unpleasant, synthetic, chemicals
			0.1	not detectable
MOBIL vectra 4	lubricants, from petroleum base stocks blended with selected additives	unidentified volatiles	10	strong, intensive, mineral oil, petroleum
			0.1	mild, petroleum, lubricant, mineral oil
GERALYN grease 2	lubricant, highly refined paraffin oil and metal complex thickener and anti-corrosive agents, solid lubricants	no volatiles detected	10	not detectable
			0.1	not detectable
CORENA OIL P	air compressor lubricant, mineral oil based	no volatiles detected	10	mild, chemical, synthetic, hydrocarbon
			0.1	not detectable
MOBIL grease XHP 222	grease, based on paraffinic mineral oils	decane, dodecane, hexadecane, unidentified volatiles	10	petroleum, synthetic, mineral oil
			0.1	mild, mineral oil
GERALYN spray	anti-friction bearing grease, based on paraffin oil, metal complex thickener	tridecane, tetradecane, unidentified volatiles	10	strong, chemical, disinfection, chlorine
			0.1	almost not noticeable
KONKOR 101 – spray	anticorrosion and lubricating agent, mineral oil based	tetradecane, pentadecane, 1-nonylcyclohexane, hexadecane, heptadecane	10	strong, petroleum, hydrocarbon, mineral oil
			0.1	mild, lubricant
SILKAL 93	lubricant, silicon oil	2-methylnonadecane, heptadecane, unidentified volatiles	10	strong, chemical, synthetic
			0.1	almost not noticeable
Industrial Petrol 90/150	petrol for technical (industrial) purposes: cleaning, degreasing	2-methylheptane, 3-methylheptane, octane, 2-methyloctane, nonane	10	strong, petrol, petroleum
			0.1	mild, petrol

was inserted into the headspace 10 ml vial filled with 5 ml of sample and agitated, the optimised extraction conditions were: 30 min at 40°C. Sample analyses were performed on an Agilent Technologies (GC 6890N), equipped with a mass detector (MS 5973) and DB-5MS column (30 m × 0.25 mm i.d. × 0.25 um film thickness). The split (1:10) GC inlet was maintained at 250°C and desorption time of 2 min was used. The carrier gas (He) flow was 1.2 ml/min. The following temperature program was used: 50°C (held 5 min), ramped at 5°C/min to 150°C, ramped at 10°C/min to 220 (held 2 min).

Sensory analyses. The difference in odor between control (distilled water) and suspected samples or model samples of potential contaminants was evaluated by triangle tests; subsequently the defect was defined by descriptive sensory analysis.

RESULTS AND DISCUSSION

Several samples of natural spring waters produced by local producer were returned back by consumers to have unacceptable taste and odor. The descrip-

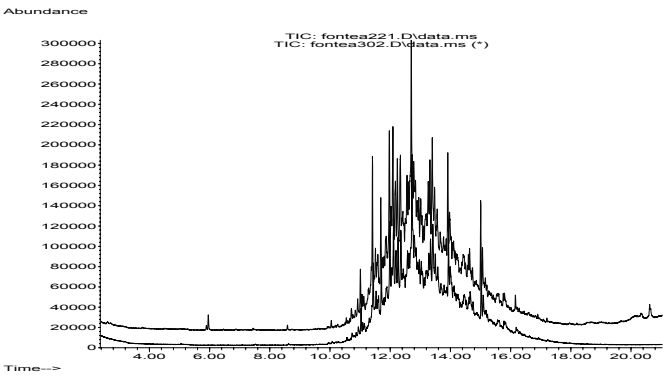

Figure 1. Overlaid chromatograms of volatile compounds profile of suspect sample and anticorrosion and lubricating agent Konkord 101 (dilution 1: 10 000), compounds identified in both samples: perhydrophenalene, tetradecane, pentadecane, 1-nonylcyclohexane, hexadecane, heptadecane, 2-butyldecahydronaphtalen, the total concentration of hydrocarbons in suspected sample: 0.3 mg/l

tive sensory analysis proved organic, petroleum, hydrocarbon taint of suspected samples. The defect occurred randomly in one batch of products, about 20 defected bottles were collected which differed in the intensity of off-flavor, 3 of these samples were subjected to instrumental analysis.

To identify the source of brake-down, all maintenance agents and chemicals in maintenance workshop were analysed by SPME/GC/MS and model samples of water spiked with different concentration of individual agents were subjected to the sensory analyses, the results are given in Table 1. The suspect sample was compared with aroma profiles of potential contaminants, and the cause of contamination was identified as anticorrosion and lubricating agent, not permitted for the food contact, Konkord 101 (Figure 1). The SPME/GC/MS analyses proved the content of significant concentrations (higher than the limit for drinking water being of 0.05 mg/l) of aliphatic straight- and branched-chain and aromatic hydrocarbons.

Considering the results of analysis: limited number of non-conformed samples with decreasing concentration of contaminants were found, the defective samples were related only to one batch produced within several hours, etc., indicated as potential the cause the maintenance action on bottles blowing machine. The complaints were caused by the incorrect use of the anticorrosion and lubricant agent Konkord 101 for the liberation of moving mechanism of forms in bottle blowing machine. The agent is not food grade product, it cannot be used for this purpose, if it is used, the machine must be cleaned before and/or the bottles must be removed until they contain residues of agents. The outputs of the case study were used to improve the quality and safety management system in the plant, maintenance procedures were revised and the staff was trained.

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