natural habitats was identified 6 compounds belonging to the flavonol group such as hyperoside (3356,43 μg/g), isoquercitrin (1244,62 μg/g), avicularin (1226,65 μg/g), quercetin-3-arabinopyranoside (713,61 μg/g), astragalin (689,15 μg/g), quercetin (645,8 μg/g) and kaempferol (44,77 μg/g). Epicatechin (1049,78 μg/g) and 3 types of proanthocyanidins were also detected in raw material of *Calluna vulgaris*: proanthocyanidin B2 - 1078,95 μg/g, proanthocyanidin A1 - 316.54 μg/g and proanthocyanidin B3 - 187,33 μg/g. Thus, the data obtained indicate that the predominant compounds in the extracts of *Calluna vulgaris* are chlorogenic acid, hyperoside and neochlorogenic acid, respectively. The diversity of phenolic compounds may be affected by growth conditions, climatic conditions or altitudes.

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COMPOSITION OF THE ESSENTIAL OIL OF *ARGANIA SPINOSA* (*SAPOTACEAE*) FRUIT PULP

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Introduction. Argan oil is prepared from the kernels of the fruit of the argan tree, *Argania spinosa* (Skeels) L. [1], a tree naturally growing exclusively in Morocco. Presently, a program aimed at sustainably developing the argan forest [2] ensures the production of high quality oil in cooperatives that apply stringent preparative rules [1]. One rule is the mandatory use of pulped fruit to ensure the discarding of fruit damaged by feeding goats, the use of which leads to low quality oil [3, 4]. Therefore, tons of fresh and dry fruit pulp are generated during the summer, and the rest of the year, respectively. So far, this pulp is simply used to feed cattle. To perpetuate the argan forest, sustainable uses for argan pulp are being investigated.

Of the various chemicals already isolated from argan fruit pulp, only phenolic compounds present a commercial potential [5]. The interest presently devoted to essential oils and their numerous biological effects [6] prompted us to evaluate the essential oil compositions of fresh and dried argan fruit pulp to assess their potential commercial value.

Materials and methods. Hydrodistillation, steam distillation, and microwaveassisted methods are frequently used to extract essential oils [7].

We evaluated all three methods with fresh and dried fruit pulp. Hydrodistillation consistently afforded higher essential oil yields (0.08 and 0.06%, for fresh and dried fruit argan pulp, respectively). The use of steam distillation and microwave led to essential oil yields of 0.04% (±0.01%) and 0.02% (±0.01%); respectively.

Results and their discussion. Oxygenated terpene derivatives (OTD) are the main constituents of argan fruit pulp essential oils. In dried fruit, OTD constitute 79.5% of the essential oil components and 83% for fresh fruit. Camphor was the main compound in fresh (35.5%) and dried fruit (33.9%) oils. 1,8-Cineole was present in appreciable amount in the fresh fruit oil (16.0%) but, in dry fruit pulp oil, its content was slightly reduced (7.8%), even though it remained one of the major compounds. Endoborneol and 2-(4-methylcyclohex-3-enyl)-propan-2-ol were found in similar amounts in the fresh fruit pulp oil (11.8 and 11.1%, respectively). Essential oil from dried fruit pulp contained higher amount of oxidation products. Hence, 3,5-dimethyl-4-ethylidene-cyclohex-2-ene-1-one was found as the second major component and derivatives such as furan-2-carbaldehyde and 2-methylbutanoic acid were found in higher percentages than in fresh fruit pulp.

The presence of camphor and 1,8-cineole in appreciable amounts in the pulp of the argan fruit is highly interesting. Indeed, it has been proposed that oils presenting such an association should possess insect repellant or insecticide activity [8]. Fighting insects with affordable and non-toxic compounds is a priority in the argan forest. Therefore, argan fruit pulp essential oil can be proposed to protect family households. Variations in OTD composition between fresh and dried fruit pulp should have little influence for this purpose. Our results provide the cooperatives with a new opportunity to diversify their production and offer a useful product to the local population, as well as adding value to a by-product that is wasted at the moment. Hydro-/Steam-distillation/ Microwave-assisted extraction: Fruit pulp (300 g) was cut into 5 mm strips and subjected either to hydrodistillation for 4 h in a Clevenger-type apparatus containing 400 mL of double distilled water, or to steam distillation for 3 h using an indirect steam distillation apparatus with 600 ml of deionised water. The essential oil was collected and dried overnight in a desiccator. Essential oil was stored at -18°C until analysis. Microwave-assisted extraction, was performed for 20 min using a microwave oven. GC/MS: Essential oils were analyzed by GC/MS using a Trace gas chromatograph (GC Ultra-thermo Scientific) coupled to an Agilent HP mass spectrometer. A VB-5 fused silica capillary column (30 m, 0.25 mm, 0.25 mm) was used. GC/MS operating conditions were: injector temperature 200°C; transfer line 220°C; oven temperature, from 50 to 200°C at 3°C/min; carrier gas, He at 1.4 mL/min; split ratio, 1:70. Compounds were identified by comparing their GC retention times and MS with authentic compounds, NIST MS library, and literature [9]. Quantification (expressed as percentage of total peak area of chromatogram) was carried out by peak area normalization measurements.

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