

## 7. SUMMARY

This doctoral thesis is concerned with determination of antioxidant activity of some medicinal plants and vegetable containing phenolic compounds. *Linaria vulgaris* (*Scrophulariaceae*), *Ballota nigra* (*Lamiaceae*) and *Brassica oleracea* var *costata* D.C. (*Brassicaceae*) were analyzed.

- theoretical part of this thesis deal with methods for *in vitro* determination of antioxidant activity of natural compounds especially phenolic compounds - flavonoids and phenolic acids.
- on the basis of HPLC/DAD analysis identification and quantification of phenolic compounds of *Ballota nigra* and *Linaria vulgaris* lyophilised infusions and lyophilised aqueous extract of tronchuda cabbage (*Brassica oleracea* var. *costata* D.C.) internal and external leaves was undertaken. Identification and quantification of phenolic compounds of *Brassica oleracea* var. *costata* D.C. was achieved on the basis of previous HPLC-DAD-MS/MS-ESI analysis.
- organic acids were identified and quantified by means of HPLC/UV analysis.
- the ability of tested extracts to act as scavenger of DPPH<sup>•</sup> and reactive oxygen species (superoxide radical, hydroxyl radical and hypochlorous acid) was investigated. In addition antioxidant activity of *Ballota nigra* and *Linaria vulgaris* infusions was examined against nitric oxide.

### *Ballota nigra*

- seven phenolic compounds (chlorogenic, caffeic and caffeoylmalic acids, ballotetroside, forsythoside B, verbascoside and allysonoside) and eight organic acids (oxalic, aconitic, citric, ascorbic, malic, quinic, shikimic and fumaric acids) were identified and quantified by HPLC/DAD and HPLC/UV,

respectively. Forsythoside B and quinic acid revealed to be the main compounds in this infusion. The tested infusion mainly exhibited a potent scavenging effect on DPPH, nitric oxide and superoxide radicals. In hydroxyl radical assay a potent pro-oxidant activity was noticed. No effect was found against hypochlorous acid.

### *Linaria vulgaris*

- The phenolic composition of the lyophilised infusion was also determined by HPLC/DAD and four compounds were quantified, but, despite its high content, only linarin was managed to be identified. The HPLC/UV analysis allowed the identification and quantification of eight organic acids (oxalic, aconitic, citric, ketoglutaric, ascorbic, malic, shikimic and fumaric acids). Ascorbic acid was dominant compound presenting 23.5 g/kg of total organic acids.

- The obtained data indicated that the infusion had a good scavenging activity against superoxide radical and was a very potent nitric oxide and DPPH scavenger. In hydroxyl radical assay a pro-oxidant capacity was noticed, especially for concentrations higher than 31.25 µg/ml. No effect was found against hypochlorous acid.

### *Brassica oleracea* var. *costata* D.C.

#### External leaves

- Four samples of tronchuda cabbage external leaves different in type of cultivation and time of harvesting were investigated.
- The aqueous lyophilized extracts of tronchuda cabbage external leaves presented different phenolic compositions. Thirteen phenolic compounds (Kaempferol derivatives) and five organic acids were identified and quantified.

Sample A (from organic production, collected in November) was the one with the highest amount of phenolics (ca. 1231 mg/kg), kaempferol 3-O-(feruloyl/caffeoyl)-sophoroside-7-O-glucoside being the main compound (26% of total identified compounds). As observed for phenolic compounds, sample A exhibited the highest content of organic acids (ca. 55 g/kg).

- Tronchuda cabbage extracts exhibited antioxidant capacity in a concentration-dependent manner in all assays, although some pro-oxidant effect was also noticed. The highest antioxidant activity showed sample A.

#### Internal leaves

- Seventeen phenolic compounds and seven organic acids were characterized and quantified.

- The hot water extract of tronchuda cabbage internal leaves exhibited antioxidant capacity in a concentration dependent manner against all tested radicals. The results were compared with antioxidant activity of external leaves which were analyzed at the same time. Despite the antioxidant capacity exhibited by tronchuda cabbage internal leaves, in general terms and according to the results obtained in all assays, they exhibited lower antioxidant potential than external leaves. This can be ascribed to the higher content of both phenolics and organic acids in the external leaves, which are known to have antioxidant activity.