

Oregano - an Aromatic but Loaded Culinary Herb

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Background

As a seasoning herb, oregano, lends a strong, aromatic-herbal taste that is essential for the Mediterranean kitchen. Our routine analyses on dried, crushed oregano from individual shops and wholesalers, as well as food processing plants impressively show that it is worth paying more attention to various quality aspects of the popular herb. Three major issues have been identified: comparatively frequent violations of pesticide maximum residue levels (MRLs), toxicologically critical levels of harmful pyrrolizidine alkaloids (PA) and myriad cases of food fraud with adulterated plant material. From 2019 to the end of 2021, a total number of 77 samples of dried oregano have been analyzed in two individual investigation periods.

Adulteration

Typically, dried oregano refers to the dried yellowish to greenish leaves, as well as the petals and upper stems of the *Origanum vulgare* L.. In 2019, approximately 20 % of the samples were adulterated with substantial amounts of olive tree, rockrose and/or myrtle leaves, in order to maximize on profit (see Fig. 1). In fact, one sample labeled as “oregano” consisted of only 35 % oregano, whereas the remaining 65 % were identified as olive leaves.



Fig. 1: Stereomicroscopic photos (10x magnification) of crushed oregano, olive, rockrose and myrtle leaves

As a result, the so-called “oregano” samples were judged to be fraudulent in terms of their identity and composition. In contrast, much more positive results were achieved in 2021. Recently, only one of 36 oregano samples was detected with foreign plant material in the form of rockrose leaves, composing 10 % of the sample.

Pyrrolizidine Alkaloids

Pyrrolizidine alkaloids (PA) are naturally occurring substances that serve to protect some plant species from pests. Unsaturated PAs and their N-oxides are unwanted in food, as they are suspected of being genetically harmful and have been shown to cause cancer in animal experiments [1].

In 2019, levels of PA detected in the analyzed oregano samples were significantly above average, as high as 32,400 µg/kg. The average PA amount (41 samples) was 6,160 µg/kg (median: 5,430 µg/kg). PA findings in the oregano samples resulted from a co-processing with PA-forming foreign plants during the harvest.

Fortunately, the current analyses from 2021 show a significant reduction of PA in oregano (see Fig. 2). The average amount detected in 2021 (36 samples) was 1,206 µg/kg, a reduction of 80 % (median: 822 µg/kg). The highest level of PA observed in the current oregano samples was 8,600 µg/kg. The majority of analyzed oregano samples from 2021 (61 %) contained less than 1,000 µg/kg of PA, an amount that is not considered to be a health risk. In contrast, only 25 % of the oregano from 2019 were at this level.

Even though this is a very positive development, there is still a high amount (39 %) of oregano sold in supermarkets that contain PA levels above 1,000 µg/kg, representing EU-wide legal maximum level for PA in oregano since July 2022. Toxicologically highly concerning PA-levels of over 10,000 µg/kg, as were found in 24 % of samples in 2019, fortunately were no longer observed in 2021.

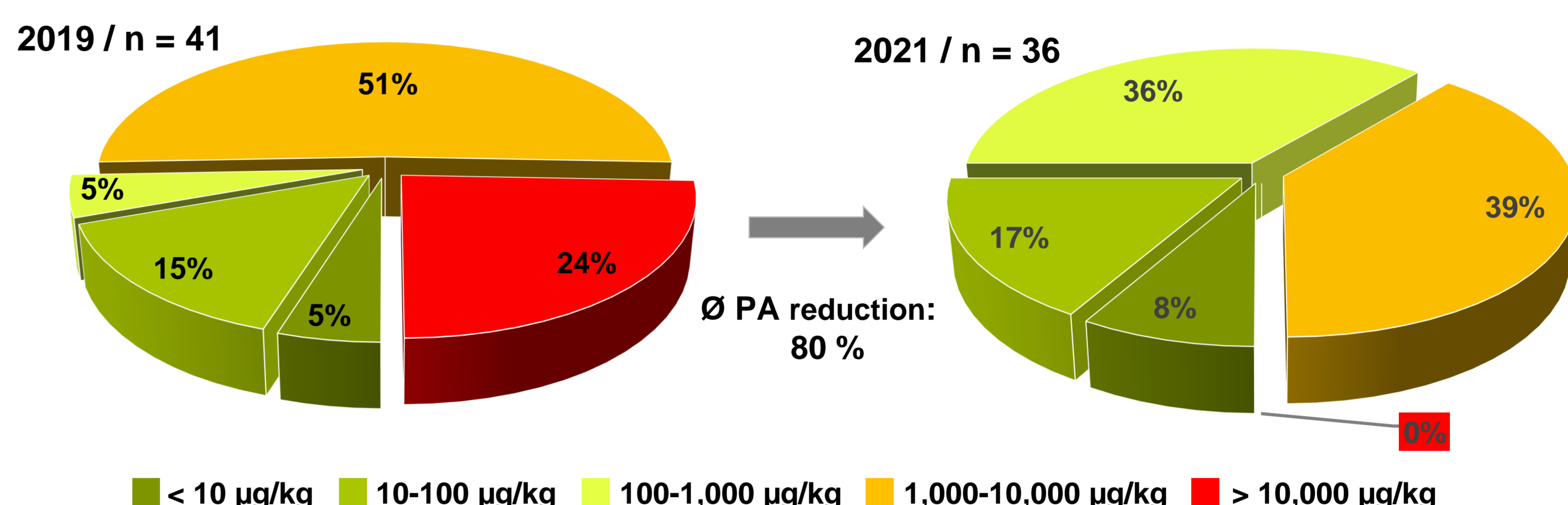


Fig. 2: Quantities of pyrrolizidine alkaloid (PA) in oregano from two individual investigation periods

Pesticides

In contrast to the positive development regarding PAs and adulterations, the situation for pesticide residues has remained largely unchanged compared to our investigations in 2019. A total of 59 oregano samples were analyzed for residues of over 750 different pesticides and contaminants (perchlorate). Residues from a total of 38 different pesticide substances and perchlorate were determinable in 100 % of the samples. Multiple residues were detected in 50 (85 %) of the analyzed samples. One such sample was detected with as many as 7 different substances. On average, each sample contained 4.5 different substances. The relevant residue findings are presented in Table 1.

Tab. 1: Residues of the relevant pesticides and contaminant found in dried oregano; sample no.: 59

Substance*	Samples w. residues (%)	Min (mg/kg)	Max (mg/kg)	MRL** (mg/kg)	No. > MRL**
Azoxystrobin	28 (47.5 %)	0.010	1.1	70	-
Chlorate	2 (3.5 %)	0.006	0.075	0.010	1
Chlorpyrifos	17 (28.8 %)	0.005	0.16	0.020	1
Cyfluthrin	5 (8.5 %)	0.046	0.24	0.020	3
Cypermethrin	26 (44.1 %)	0.013	2.2	2.0	****
Deltamethrin	14 (23.7 %)	0.029	0.29	2.0	-
Fluazifop	17 (28.8 %)	0.005	2.7	0.020	8
Pendimethalin	22 (37.3 %)	0.010	0.044	0.60	-
Perchlorate	59 (100 %)	0.035	1.7	0.20***	1
Pyriproxyfen	4 (6.8 %)	0.12	0.20	0.050	2

* Only substances with MRL exceedances or frequent findings (> 20 %) are presented

** MRL = Maximum Residue Level

*** Reference value for perchlorate in leafy vegetables

**** No. MRL exceedances under consideration of drying factor (DF 6)

Pesticides that are effective as weed-killers (2,4-D, fluazifop and pendimethalin) as well as insecticides from the substance class of pyrethroids (cypermethrin, lambda-cyhalothrin and deltamethrin) and the fungicide azoxystrobin were most frequently detected. All of the samples were also found to contain the contaminant perchlorate. Residue amounts exceeding the established maximum residue levels (MRL) were most frequently observed for the herbicide fluazifop (8 x >MRL; 14 %). Besides fluazifop, the insecticides cyfluthrin (3x >MRL), pyriproxyfen (2x >MRL) and chlorpyrifos (1x >MRL) were also especially relevant. The rate of violations of pesticide MRLs for dried oregano was 22 %, a high value compared to other vegetables or fruit.

Conclusion

Somewhat better, but not yet perfect – this sums up the development of dried oregano’s qualitative characteristics in a short but succinct way. However, CVUA Stuttgart will continue to focus on this product group and will report on future developments.

Literature

[1] Federal Institute for Risk Assessment (BfR), Opinion Nr. 030/2016, 2016

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