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UNVEILING THE HEALTH BENEFITS OF PLANT PHYTOCHEMICALS: AN ETHNOBOTANICAL OUTLOOK ON THE NUTRITIONAL AND MEDICINAL ADVANTAGES OF VEGETABLES, SPICES, AND MEDICINAL PLANTS

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Abstract

The exploration of alpine plants, particularly Peucedanus Ostruthium(L.) W.D.J. Koch, offers promising avenues for innovation in the food, cosmetics, and pharmaceutical industries. This study focused on twelve eco-types of swat mountains, conducting a comparative analysis to provide well-characterized plant material for various industries. The research investigated the diversity of eco-types, dry matter production of aerial and underground parts, and essential oil and strutting content during spring and autumn harvests. Results showed significant variability among eco-types, with specific ones demonstrating high productivity in different plant organs. Peucedanus Ostruthium, a perennial hemicryptophyte, was found to thrive in moist meadows from subalpine to alpine levels. The study, conducted at an experimental site in Bruson, evaluated the impact of environmental conditions on field trials, emphasizing soil characteristics, fertilization, and irrigation. Collections and analyses were performed on aerial portions and rhizomes during spring and autumn harvests. The findings highlighted the influence of harvest date on vegetative development and essential oil production. The study identified eco-type 11 as a robust performer, exhibiting high yields of essential oils and strutting. This eco-type was selected for seed production, and the cultivation experiments are underway. The germination process for imperative seeds was explored, emphasizing the importance of temperature conditions.

Introduction

The food, cosmetics, and pharmaceutical industries always seek new ideas. The variety of phytochemicals found in alpine plants piques their curiosity in particular. Due to its anti-inflammatory, stimulant, and lung disease properties (Hos Littmann 2017, for example), the herb has a well-established reputation in conventional medicine. It presents exciting opportunities for the creation of new goods. Additionally, recent phytochemical research on coumarins found in the rhizomes of the crucial plant, particularly strutting, shows intriguing antidepressant and anxiolytic properties for the treatment of cardiovascular diseases ,mycobacterial lung infections and Alzheimer's disease .Manufacturers must have well-characterized plant material to apply ethnopharmacological and phytochemical expertise to create finished products. This suggests, among other things, that the selection of stable eco-types as well as it was to analyze the dry matter production of the aerial and underground sections, as well as their essential oil and strutting content, in spring and autumn (Panova, Varfolomeeva et al. 2023).

Figure 1: Plants containing phytochemicals

Botany and plant material

GenrePeucedanum is a member of the Apia family and has more than 120 species throughout Europe, Asia, and Africa. The Sudetes to Spain and Italy are among the mountain ranges in central and southern Europe where the imperative (Peucedanus Ostruthium(L.) W.D.J. Koch) is indigenous. It is frequently discovered as a naturalized species on the east coast of North America, in England, and in northern European nations. This perennial hemicryptophyte is widespread in the Swat Mountains and prefers moist meadows, and it metaphorizes from subalpine to alpine levels. Its vegetation grows to a height of 40 to 100 cm. It has a somewhat tuberous root. Its stems are ribbed and hollow. Three large trilobed, occasionally trisected, serrated segments make up its leaves. The petioles on the top ones are broad-sheathed. Its pinkish-white or white in Flores are In the spring of 2013, the rhizomes of the twelve eco-types of imperative heath were collected in nature, in different Valais alpine valleys, at an altitude between 1407m and 1821m (fig. 2a and 2b). They were propagated vegetatively by the division of rhizomes and raised in the nursery for two months (Johnson and Fletcher 2023).

Twelve important eco-types of Peucedanus ostrich, originating in the Swat Mountains, were the subject of a comparative study to provide pharmaceutical, cosmetic, and agri-food businesses with well-characterized plant material (Ricketts, Heckman et al. 2023). We examined the eco-types' diversity, the aerial and subsurface portions' dry matter production, and their essential oil and strutting Content. Harvest dates in the spring and the fall were also taken into account. The spring harvest was favorable for the aerial parts' dry matter yield (668g/m2) and actual oil output (0.31

percent, 2.03ml/m2). On the other hand, despite a lower content of 0.39% in October compared to 0.63% in May, the autumn harvest was advantageous for producing rhizomes and roots in terms of biomass yield (1150g/m2) and essential oil (4.56ml/m2) (Alavi-Siney, Saba et al. 2023).

Ostruthine was only present in detectable amounts in the subsurface portions. The phenotypic and phytochemical heterogeneity of the wild eco-types was notable for the parameters tested. The selection of a robust eco-type, productive in aerial and subsurface portions and rich in strutting, was made as a result of the study of these findings. The conservation of this eco-type and seed production has been organized to satisfy future market demands and encourage the cultivation of this species (Alavi-Siney, 2023 #1077).

Figure 2a | Harvesting imperative rhizomes

Environmental conditions for field trialsOn the Agroscope experimental site in Bruson (Val de Bagnes, VS), at an altitude of 1060m, in slightly acid morainic soil (pH 6, 6), and well-supplied with organic matter (3%), the field experiment was conducted from July 2013 to October 2015. Mesa was the preceding crop. Based on soil analysis, fertilizer (N-P-K: 55-25-75kg/ha) was applied in 2014 and 2015. A sprinkler irrigation of 30mm per week was offered throughout the vegetation months, from May to October. Twelve 13m2 elementary ones made up the experimental apparatus. At a density of 4.7 plants/m2, the plants were planted on a border of three lines 40 cm Lein (VS)

Collections and analyzes

The aerial portions and rhizomes were gathered on May 14 and 15, 2015, between October 12 and October 19, 2015. The drying process was placed in an electric air dryer at 38°C. When precipitation does not meet this criterion, it is pulsed until a lower water content is attained. Less than 12% 52 (2): 96–103, 202097 Swat Review Viticulture, Arboriculture, Horticulture (Iqbal, Hameed et al. 2023).

Results and discussion

impact of the harvest date

The vegetative development native of the imperative was satisfactory in the second year of growth. The foliage's hygienic condition was impeccable in May 2015, although Table 1 shows the ratio of the underground to the aerial sections, the yield of dry matter, the Content and yield of essential oils, and the potential antioxidant [EC50] of the underground and aerial parts of the herb. 2015 is Bruson's second year of cultivation, with spring and fall harvests. Typically twelve eco-types (Dyson, Dawwas et al. 2023).

Table 1 : underground to the aerial sections

Organs	Factor	Unit	Spring	Autumn
Underground parts /aerial parts	Ratio	[1]	0,66 b	3,51 a*
Aerial parts	Yield in dry matter	[g/m^2]	668 a	371 b
	Essential oil content	[ml/100 g MS]	0,31 a	0,20 b
	Essential oil yield	[ml/m^2]	2,03 a	0,78 b
	Ostruthin Content	[g/100 g MS]	n.d.	n.d.
	Ostruthin yield	[g/m^2]	n.d.	n.d.
	EC_{50}	[1]	2,5	2,5
Underground parts	Yield in dry matter	[g/m^2]	429 b	1150 a*
	Essential oil content	[ml/100 g MS]	0,63 a	0,39 b
	Essential oil yield	[ml/m^2]	2,69 b	4,56 a*
	Ostruthin Content	[g/100 g MS]	1,74 a	1,41 b
	Ostruthin yield	[g/m^2]	7,5 b	16,4 a
	EC_{50}	[1]	2,7	2,8

DM: dry matter; CE_{50}: effective concentration 50%; n.d.: not detected.

Small letters indicate significant differences (p>0.05); Tukey test or Kruskal-Wallis test*

98 52 (2): 96-103, 2020, Swat Review Viticulture, Arboriculture, Horticulture Figure 2b shows the imperative's vegetative division by rhizome division. In October, the leaves displayed a lot of dark necrotic patches, most likely caused by a fungus that causes senescence. Of the twelve eco-types, the dry aerial component biomass was, on average, 668g/m2 in the spring vs. 371g/m2 in the fall. In contrast, the autumn harvest was substantially more beneficial for production in the underground areas, with a dry matter yield of 1150g/m2 compared to 429g/m2 in the spring (table 1). The average amount of essential oils was cc0.31% and 0.63%, respectively, in the spring, compared to 0.20% and 0.39%, in the autumn. The subsurface components had roughly twice as much essential oil as the aerial components (fig. 4). These numbers are much lower than those found in a Polish study on wild material from the Sudeten mountains, which saw 1.25% in the rhizomes and 0.95% in the aerial portions, respectively, of the plant. However, neither the age nor the date of the col plant reading is mentioned in this study. A spring harvest, which results in an essential oil yield of 2.03 ml/m2 from the aerial parts as opposed to 0.78 ml/m2 in an autumn harvest, is preferred. On the other hand, the generation of essential oil in the fall for the underground sections (Tufail, Ahmad et al. 2023), Based mainly on the organ harvested, the essential oil's Content, as examined in eco-type 11, varied. Sabinene (14.5%) and a-humulene (9.2%) were the two main volatiles found in the aerial parts in the spring, and sabinene (17.3%) and germacrene D (8.1%) in the autumn. Sabinene was also present in the underground regions in lower concentrations (5.4% to 5.8%, depending on the time of year) and substantial concentrations of 4-terpineol (13.3% to 6.1%). Without mentioning the harvest date, Cisowski et al. (2001) identified 39 of the 44 peaks in the aerial portions and 29 of the 39 peaks in the rhizomes. Sabinene (35.2%) and 4-terpineol (26.6%) predominated in the rhizomes, while THEb-caryophyllene (16.1%) and the-humulene (15.8%) did so in the aerial portion (table 2) (Bello, Lawal et al. 2023).

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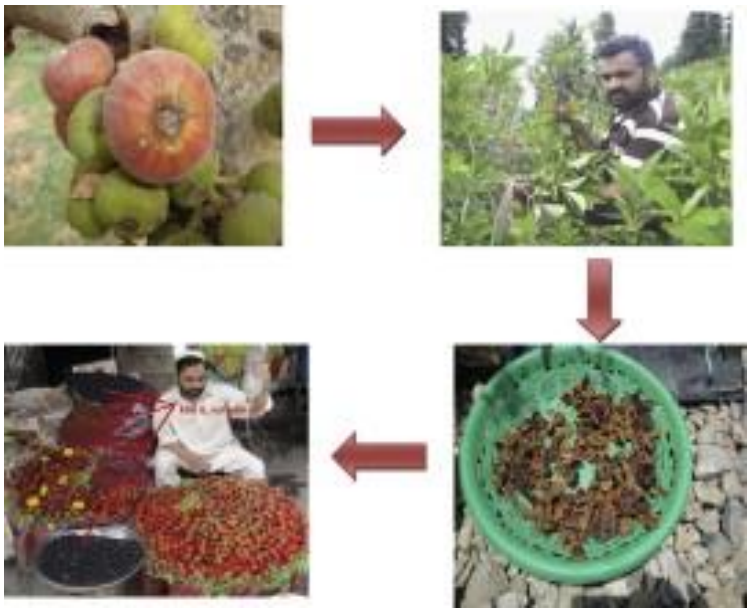

Figure 2b

Variability of eco-types

When the twelve eco-types were compared to the field, it was clear that there was a wide variation in the production of the aerial and subsurface organs in terms of dry matter and active principles. Eco-types 5, 9, and 11 were the most productive for producing aerial components, with a dry matter output of more than 0.8 kg/m2 and never less than 0.5 kg/m2 in October. Autumn had a high dry rhizome biomass. With more than 1.2 kg/m2, Eco-types 1, 5, 6, 7, 9, and 11 stood out (fig. 4). Parties' hydrodistillation air allowed us to identify eco-types 3, 6, 7, and 9, given their essential oil content and yield (table 3). In the rhizomes, eco-types 1, 5, 7, and 11 were the most perform (Panova, Varfolomeeva et al., 2023) coats (tab. 3).

The yield of strutting was exceptionally high with eco-type 11 during the October harvest (table 4). A summary of these results led to the choice of eco-type 11 as the gene pool for producing a first line of commercial seeds.

Seed production

Eco-type 11 rhizomes were gathered and divided multiple times in the fall of 2016. The cuttings were planted in a plot apart from the natural populations in June 2017 after maturing in culture plates (4.8 cm) for eight months to prevent genetic contamination. This umbellifer produces seeds rather quickly, reaching a 46g/m2 rate in 2018. The selection's initial cultivation experiments are now being conducted. Sample slots of origin have already been sent to Italy and Austria (Johnson and Fletcher 2023).

Condition de germination

The multiplication of the imperative generative way remains random because of the shallow morpho-physiological dormancy of the seeds (Novak *et al.*2011). Our experience shows that even with roots whose viability certified by a tetrazolium test was close to 90%, germination is Table 2 |Profile of the essential oil of eco-type 11 at Bruson in 2015 in the aerial and underground parts of the imperative. Spring and autumn harvests of eco-type n°11 at Bruson in 2015 compared to the literature (Alavi-Siney, Saba et al. 2023).

Table 3

Compounds	[%] in essential oil					
	Literature (Cisowski et al., 2001)		Ecotype 11 at Bruson 2015			
			spring		autumn	
	Herbs	Rhizomes	Aerial parts	Underground parts	Aerial parts	Underground part
Sabine	4,7	35,2	14,5	5,4	17,3	5,8
cis-Ocinemus	6,4	t	1,9	0,2	2,5	0,2
4-Terpineol	1,5	26,6	0,5	13,3	0,2	6,1
b-Caryophyllène	16,1	0,1	2,8	0,3	1,2	0,3
a-Humulene	15,8	t	9,2	n.d.	3,4	n.d.
Germacrene D	9,6	0,8	1,3	1,0	8,1	0,7
Osthole	5,5	5,1	n.d.	n.d.	n.d.	n.d.

t.: trace; n.d.: not detected.

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choosing a crucial ecotype (Peucedanus Ostruthium(L.) W.D.J. Koch)| Slow and erratic aromatic and medicinal plants. In Petri dishes on blotting paper, vernalization for four weeks at one °C with germination climate conditions of 25°C/16h of light and 18°C/8h of darkness produced our most outstanding results. 24% of the seeds have germinated after 20 days, and 53% have after 30 days. An Austrian trial with field-harvested seeds demonstrated the beneficial effect of temperature on germination. The best results were observed at a temperature of 26°C, with 38 to 45% germination at the end of seven weeks of control, mainly between the second and third week (Novak *et al.*2011). In the current state of knowledge, the recommendation is to subject the seedlings to a high temperature, if possible 26°C. This advice is surprising for a mountain species, but Sayers and Ward (1966) suggest that this mechanism would be vital to Table 3 |Content and yield of essential oil in twelve imperative eco-types' aerial and underground parts. Spring and autumn harvests in the second year of cultivation at Bruson in 2015 (Ricketts, Heckman et al. 2023).

Table 4 Aerial parts essential oil

Eco-types	Aerial parts Essential oil				Underground parts Essential oil			
	Teneur [ml / 100 g MS]		Yield [ml/m^2]		Teneur [ml / 100 g MS]		Yield [ml/m^2]	
	Spring	autumn	Spring	autumn	spring	autumn	spring	autumn
1	0,33	0,18	1,01	0,73	0,93	0,62	2,64	8,07
2	0,37	0,32	1,63	1,20	0,76	0,50	2,10	4,11
3	0,38	0,30	2,27	0,99	0,90	0,34	3,23	2,63
4	0,26	0,14	2,15	0,40	0,56	0,35	2,19	3,17
5	0,34	0,11	2,73	0,59	0,83	0,46	5,20	6,29
6	0,29	0,30	2,55	0,97	0,68	0,41	3,39	5,18
7	0,33	0,29	1,92	1,42	0,54	0,53	2,91	8,08
8	0,41	0,17	2,58	0,38	0,32	0,24	0,99	2,26
9	0,30	0,26	2,53	1,41	0,46	0,36	2,13	4,55
10	0,24	0,07	1,45	0,10	0,45	0,27	1,88	2,48

Conclusions

- This work led to the proposal of an optimal harvest date according to the parts of the plant harvested and the active ingredients sought, as well as the selection of a high-performance eco-type.
- For the production of aerial parts of an imperative apple, the dry matter yield and the actual oil content are higher in the spring.
- Ostruthine content and yield of the underground parts of twelve imperious accessions. Autumn harvests in the second year of cultivation at Bruson in 2015.
- For the production of rhizomes, the autumn harvest is indicated, ideally at the end of the second or third year of cultivation (Iqbal, Hameed et al. 2023).

- Only the underground parts contain strutting.
- The phenotypic and phytochemical variability of wild eco-types is significant.
- The production of seeds of a vigorous selection, productive in aerial and underground parts, rich in strutting, has been organized. A cultivar called “Jessy” is marketed by mediSeeds (www.mediseeds.ch).

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