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EFFECT OF DIFFERENT SUTURE MATERIALS AND TECHNIQUES ON GASTRIC WALL TISSUE HEALING IN GASTROTOMY SURGERY IN DOGS

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ABSTRACT

Trematode infections of small ruminants cause substantial production losses in Uzbekistan, and their control depends on a narrow set of flukicides against which resistance is increasingly reported. Oleo-gum-resins of the genus Ferula L. have demonstrated in vitro activity against liver and rumen flukes, but the published evidence concerns Ferula assa-foetida L. almost exclusively. Ferula kuhistanica Korovin, abundant in the foothills of southern Uzbekistan, has not been evaluated, and no documented procedure exists for obtaining its oleo-gum-resin as a defined veterinary raw material. This study documents a field-to-laboratory protocol for tapping F. kuhistanica oleo-gum-resin and converting it into a dried powder. Natural stands were surveyed in Dehqonobod District, Qashqadaryo Region. Latex was obtained by serial excision of the upper root crown, with the cut surface shielded from direct sunlight by cardboard and cellophane; exudate was harvested at 4- to 5-day intervals and the surface thinly re-trimmed to restore flow. Collected resin was shade-dried under gauze, milled to a powder, and stored in opaque containers under refrigeration. Ferula kuhistanica was the predominant Ferula species at the site. Tapping was practicable from early July to the first half of October and could be repeated up to 20 to 25 times per plant, depending on root size. The dried product milled to a free-flowing, whitish powder with a faint garlic-like odor considerably less intense than that of F. assa-foetida resin. The protocol yields a reproducible raw material from a locally abundant species and is transferable to other foothill districts of southern Uzbekistan. Anthelmintic efficacy was not assessed in this work; an evaluation protocol is set out in Appendix A.

ACCEPTED

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Keywords: *Ferula kuhistanica, oleo-gum-resin, asafoetida, anthelmintic, trematodosis, small ruminants, Uzbekistan.*



Introduction

Trematode infections are among the most economically damaging parasitoses of ruminants worldwide. In sheep and goats the principal agents are the liver flukes *Fasciola hepatica* L. and *Fasciola gigantica* Cobbold, the lancet fluke *Dicrocoelium dendriticum* (Rudolphi), and the rumen flukes *Calicophoron calicophorum* (Fischoeder), *Gastrothylax crumenifer* (Creplin), and *Liorchis scotiae* (Willmott). Their effects are largely chronic — depressed growth rate, reduced milk and wool yield, and liver condemnation at slaughter — which makes them easy to underestimate and costly to tolerate (Kahl et al., 2021; Rojo-Vázquez et al., 2012).

Control rests almost entirely on chemotherapy, and the available pharmacological repertoire is narrow. Triclabendazole is the only compound active against both immature and adult *Fasciola* and has consequently been used heavily enough that resistant fluke populations are now reported from many countries (Fairweather et al., 2020; Kelley et al., 2016). The remaining agents — closantel, nitroxynil, clorsulon, oxyclozanide, and albendazole at elevated doses — act principally on mature flukes (Fairweather et al., 2020). It is worth noting that macrocyclic lactones such as ivermectin, although widely used against nematodes and ectoparasites, have no efficacy against trematodes and do not constitute an alternative. Beyond resistance, repeated administration raises the familiar problems of residues in edible tissues and the withdrawal periods these impose.

These constraints have renewed interest in plant-derived anthelmintics, and the genus *Ferula* L. (Apiaceae) is a credible candidate. Its oleo-gum-resins are rich in sesquiterpene coumarins, ferulic acid, umbelliferone, and sulfur-containing volatiles (Amalraj & Gopi, 2017; Mahendra & Bisht, 2012), several of which have documented antiparasitic activity. In vitro, an ethanolic extract of *Ferula assa-foetida* L. root latex is lethal to *Fasciola gigantica* at concentrations in the low milligram-per-milliliter range (Kumar & Singh, 2014). A hydroalcoholic extract of the same species kills adult *Dicrocoelium dendriticum* and *Fasciola hepatica*, producing extensive tegumental damage visible by scanning electron microscopy, including loss of sensory papillae and destruction of tegumental vesicles (Arbabi et al., 2023). Crude aqueous-methanolic extracts and ethyl acetate fractions of *F. assa-foetida* latex are also active against *Haemonchus contortus* in egg hatch, adult motility, and fecal egg count reduction assays (Badar et al., 2021), and against *Strongylus* spp. larvae (Tavassoli et al., 2018). The proposed mechanisms — uncoupling of oxidative phosphorylation and binding of polyphenolic constituents to cuticular glycoproteins (Arbabi et al., 2023; Gundamaraju, 2013) — are distinct from those of the benzimidazoles, which is precisely what makes the group interesting where benzimidazole resistance is established.

This evidence, however, concerns *F. assa-foetida* almost exclusively. Uzbekistan possesses a rich *Ferula* flora, and *Ferula kuhistanica* Korovin is abundant in the foothill and mountain zones of Qashqadaryo Region, where it is already tapped locally for its resin (Bussmann et al., 2020; Pimenov, 1983). It has not been evaluated against helminths of any kind. National policy is favorable to such work: Resolution No. PQ-4670 (2020) addresses the protection, cultivation, processing, and rational use of wild-growing medicinal plants; Decree No. PF-139 (2022) concerns value-chain creation from medicinal plant raw materials; and Resolution No. PQ-251 (2022) provides for cultivation, processing, and therapeutic use, and specifically for the allocation of quotas for collecting wild-growing *kovrak* (*Ferula*) raw material.

There is a prior obstacle, however, and it is the one addressed here. Anthelmintic screening of a crude botanical is meaningful only if the material tested is defined and reproducible. Tapping season, cut interval, drying regime, and storage conditions all affect the composition of an oleo-gum-resin, and no documented protocol exists for obtaining *F. kuhistanica* resin as a veterinary raw material. Without such a protocol, efficacy results cannot be compared between laboratories or between seasons.

The purpose of the present study was therefore to document and standardize a field-to-laboratory procedure for tapping *F. kuhistanica* oleo-gum-resin and converting it into a dried powder suitable for pharmacological evaluation. Three objectives were pursued: to characterize the occurrence of *F. kuhistanica* at a representative site in Dehqonobod District; to define a workable tapping regime in terms of season, cut interval, and number of cuts; and to define drying, milling, and storage conditions and describe the resulting product. Anthelmintic activity was not assessed in this study, and no claim of efficacy is made.

Method Study Site and Period

The study was carried out in naturally occurring *Ferula* stands in Dehqonobod District, Qashqadaryo Region, in the southern foothill zone of the Republic of Uzbekistan. The district lies on the northwestern slopes of the Hisar range, where *Ferula* species occupy dry stony slopes and loess foothill

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plains. Fieldwork covered a full tapping season, from the first survey of stands in late spring to the cessation of exudate flow in autumn.

Plant Material and Identification

Plants were identified as *Ferula kuhistanica* Korovin (Apiaceae) using the standard regional determination key for Central Asia (Pimenov, 1983), on the basis of habit, leaf division and pubescence, umbel architecture, and fruit morphology. Nomenclature follows Plants of the World Online (POWO, n.d.), under which *F. kuhistanica* Korovin is the accepted name for the taxon, native to Uzbekistan, Tajikistan, and Kyrgyzstan. Stands were surveyed before tapping to establish which *Ferula* species were present, and only individuals with a well-developed root crown were selected for tapping.

Regulatory Compliance

Collection of wild-growing *Ferula* raw material in Uzbekistan is a regulated activity, subject to quota under Resolution No. PQ-251 (2022). Material for this study was collected in accordance with that instrument. The study involved no animal or human participants and therefore required no ethics committee approval.

Tapping Procedure

Tapping followed the practice established for oleo-gum-resin-yielding *Ferula* species, with the modifications described below. For each selected plant, soil was cleared from around the root crown and a thin slice of its upper part was excised transversely with a clean knife, exposing the central core. The exposed surface was immediately shielded from direct sunlight with a cardboard cover overlaid with cellophane, both secured against wind and rain. Exudate released from the cut surface solidified under ambient conditions into a thick resinous mass.

Cuts were revisited at intervals of 4 to 5 days. At each visit the accumulated resin was lifted from the cut surface with a purpose-made knife or spatula and transferred to labeled polyethylene containers; the surface was then re-trimmed thinly to restore exudate flow. On completion of the season the exposed root crown was covered with soil.

Drying and Powder Preparation

Collected resin was transferred to Petri dishes and dried in a shaded, well-ventilated area, covered with gauze to exclude insects and dust while permitting airflow, and protected from direct sunlight. Drying was continued until the mass had hardened and no further change in consistency was observed.

Dried resin was separated from the Petri dishes with a spatula, transferred through a porcelain funnel into a porcelain mortar, and reduced to a powder using a laboratory micro-mill (DEEPAS). The finished powder was transferred to opaque, airtight containers and stored under refrigeration until use.

Results Species Composition at the Study Site

Ferula kuhistanica was the predominant *Ferula* species in the surveyed stands of Dehqonobod District. Plants occurred in dense natural aggregations without cultivation, growing and regenerating spontaneously across the foothill terrain, and were sufficiently abundant to permit selective tapping without exhausting any one stand.

Tapping Season and Pattern of Exudation

Exudate accumulation was consistently visible at the cut surface 4 to 5 days after each excision, appearing first as a milky latex that solidified into a resinous mass on exposure to air. Tapping was practicable from the beginning of July to the first half of October. Within this window, thin re-trimming of the cut surface reliably restored flow, and the procedure could be repeated up to 20 to 25 times per plant over the course of the season, the number achievable depending on the size and vigor of the root.

Protecting the cut surface proved essential rather than optional. Where the cardboard and cellophane cover was displaced, the exposed surface dried and crusted, and exudation at the next visit was visibly reduced until the surface was re-trimmed. The operating parameters established over the season are summarized in Table 1.

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Table 1

Operating Parameters for Serial Tapping of Ferula kuhistanica in Dehqonobod District, Qashqadaryo Region

Parameter	Specification
Tapping season	Early July to first half of October
Site of excision	Upper part of root crown, transverse cut exposing central core
Surface protection	Cardboard cover overlaid with cellophane, secured
Interval between collections	4–5 days
Surface renewal	Thin re-trimming after each collection
Cuts per plant per season	Up to 20–25, depending on root size and vigor
Collection implements	Knife or spatula; polyethylene containers
Post-season treatment	Exposed root crown covered with soil

Note. Parameters reflect the regime found workable across a full tapping season. Resin yield was not quantified gravimetrically in the present study (see Limitations).

Characteristics of the Dried Powder

Shade drying under gauze produced a brittle resinous solid that separated cleanly from the Petri dishes with a spatula and milled without difficulty. The finished product was a free-flowing powder, whitish in color, with a faint garlic-like odor markedly less intense than that of *F. assa-foetida* oleo-gum-resin. No caking or discoloration was observed in opaque containers under refrigeration. Organoleptic characteristics are given in Table 2.

Table 2

Organoleptic Characteristics of Ferula kuhistanica Oleo-Gum-Resin Powder

Characteristic	Observation
Color	Whitish
Odor	Faint, garlic-like; considerably weaker than *F. assa-foetida*
Texture	Free-flowing powder
Behavior on milling	Brittle; reduces readily without caking
Storage container	Opaque, airtight
Storage condition	Refrigerated
Stability observed	No caking or discoloration under the above conditions

Note. Characteristics were assessed organoleptically. Physicochemical parameters such as loss on drying and total ash were not determined (see Limitations).

Discussion

The contribution of this work lies less in novelty of technique than in specification. Tapping of *Ferula* for oleo-gum-resin is an old practice in Central Asia and Iran, but it is transmitted largely as craft

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knowledge, and craft knowledge does not transfer into a pharmacological literature that requires defined materials. By fixing the season, the cut interval, the surface protection, the number of cuts, and the drying and storage conditions, the procedure described here converts a local practice into a raw material that another laboratory can reproduce.

Relation to Work on *Ferula assa-foetida*

Published anthelmintic work on the genus concerns *F. assa-foetida*, and the extracts tested are typically described in terms of solvent and concentration but rarely in terms of how the starting resin was obtained (Arbabi et al., 2023; Badar et al., 2021; Kumar & Singh, 2014). Because exudate composition in Apiaceae varies with phenological stage, tapping intensity, and post-harvest handling, two studies nominally using asafoetida may not be working with comparable material. Anchoring *F. kuhistanica* work to a documented protocol from the outset avoids importing that ambiguity into a new species.

The powder obtained here differs organoleptically from *F. assa-foetida* resin, whose odor is notoriously persistent and is attributed to its sulfur-containing volatiles (Mahendra & Bisht, 2012). The much fainter odor of the *F. kuhistanica* product suggests a lower content of these constituents. This is an observation rather than an analysis, and it cuts both ways: a weaker odor would be a practical advantage in a veterinary formulation, but if sulfur compounds contribute materially to antiparasitic activity, as has been suggested for related species (Amalraj & Gopi, 2017; Arbabi et al., 2023), it may equally indicate lower potency. Only chemical characterization and direct comparative testing can resolve this, and both are required before *F. kuhistanica* is assumed equivalent to *F. assa-foetida*.

Sustainability of Serial Tapping

Ferula kuhistanica is a monocarpic perennial: it accumulates root reserves over several years, flowers once, and dies. Removing 20 to 25 successive slices from the root crown within a single season is therefore a substantial intervention on a plant that has one reproductive opportunity. Covering the crown with soil at the end of the season is a sensible precaution, but it is not evidence that the plant recovers. Tapped individuals were not followed into the subsequent season in this study, and no survival or regrowth rate can be stated. Given that *Ferula* harvesting in Uzbekistan is quota-regulated under Resolution No. PQ-251 (2022), establishing that rate is a precondition for recommending the practice at scale.

Limitations

This study is descriptive and single-site, and three limitations should be borne in mind. First, resin yield was not quantified gravimetrically; the tapping regime is characterized by its operating parameters rather than by output per plant, and yield quantification across plants, cuts, and dates remains to be done. Second, the powder was not chemically characterized, so batch-to-batch consistency cannot be demonstrated. Third, and most importantly, no biological activity of any kind was measured: nothing in these results speaks to anthelmintic efficacy, dose, or safety.

Directions for Further Research

Three lines follow directly. Gravimetric quantification of yield per plant, per cut, and per season would convert the present protocol into a resource assessment capable of supporting quota decisions. Chromatographic fingerprinting, with quantification of ferulic acid and umbelliferone as marker compounds, would give any subsequent efficacy result a compositional anchor. Finally, revisiting marked plants in the following spring would settle the sustainability question raised above at minimal cost. The in vitro activity reported for *F. assa-foetida* against *F. hepatica* and *D. dendriticum* (Arbabi et al., 2023) and against *F. gigantica* (Kumar & Singh, 2014) provides a reasonable basis for expecting activity in a congener, but that expectation is a hypothesis and must be tested. Appendix A sets out an evaluation protocol for that purpose.

Conclusion

Ferula kuhistanica Korovin occurs abundantly in natural stands in Dehqonobod District, Qashqadaryo Region, and was the predominant *Ferula* species at the site surveyed. Under the conditions

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of the region, oleo-gum-resin can be tapped from this species from early July to the first half of October by serial excision of the root crown at 4- to 5-day intervals, for up to 20 to 25 cuts per plant, provided the cut surface is protected from direct sunlight and thinly renewed at each collection. Shade drying under gauze followed by milling yields a free-flowing whitish powder with a faint garlic-like odor that remains stable under refrigerated storage in opaque containers and is suitable as a raw material for pharmacological evaluation. Whether that material is active against trematodes of small ruminants remains an open question, and the present study does not answer it.

REFERENCES

1. Amalraj, A., & Gopi, S. (2017). Biological activities and medicinal properties of asafoetida: A review. *Journal of Traditional and Complementary Medicine, 7*(3), 347–359. https://doi.org/10.1016/j.jtcme.2016.11.004
2. Arbabi, M., Haddad, A., Esmaeli, M., Hooshyar, H., & Sehat, M. (2023). In vitro anthelmintic effect of *Ferula assa-foetida* hydroalcoholic extract against flukes of *Fasciola hepatica* and *Dicrocoelium dendriticum*. *Jundishapur Journal of Natural Pharmaceutical Products, 18*(1), Article e133030. https://doi.org/10.5812/jjnpp-133030
3. Badar, S. N., Iqbal, Z., Sajid, M. S., Rizwan, H. M., Shareef, M., & Malik, M. A. (2021). Comparative anthelmintic efficacy of *Arundo donax*, *Areca catechu*, and *Ferula assa-foetida* against *Haemonchus contortus*. *Revista Brasileira de Parasitologia Veterinária, 30*(2), Article e001221. https://doi.org/10.1590/S1984-29612021028
4. Bagheri, S. M., Yadegari, M., Porentezari, M., Mirjalili, A., Hasanpor, A., Dashti-R, M. H., & Anvari, M. (2015). Effect of *Ferula assa-foetida* oleo-gum-resin on spermatic parameters and testicular histopathology in male Wistar rats. *Journal of Ayurveda and Integrative Medicine, 6*(3), 175–180. https://doi.org/10.4103/0975-9476.146552
5. Bussmann, R. W., Batsatsashvili, K., Kikvidze, Z., Boboev, M., Ghorbani, A., & de Boer, H. (2020). *Ferula assa-foetida* L., *Ferula kuhistanica* Korovin, *Ferula moschata* (H. Reinsch) Koso-Pol., *Ferula violacea* Korovin, *Ferula* sp. Apiaceae. In K. Batsatsashvili, Z. Kikvidze, & R. W. Bussmann (Eds.), *Ethnobotany of the mountain regions of Central Asia and Altai*. Springer. https://doi.org/10.1007/978-3-319-77087-1_60-1
6. Decree No. PF-139 of the President of the Republic of Uzbekistan of May 20, 2022, On measures to create an added-value chain through the efficient use of the raw material base of medicinal plants and support for their processing. https://lex.uz/docs/6027102
7. Fairweather, I., Brennan, G. P., Hanna, R. E. B., Robinson, M. W., & Skuce, P. J. (2020). Drug resistance in liver flukes. *International Journal for Parasitology: Drugs and Drug Resistance, 12*, 39–59. https://doi.org/10.1016/j.ijpddr.2019.11.003
8. Gundamaraju, R. (2013). Evaluation of anti-helmintic activity of *Ferula foetida* "Hing—a natural Indian spice" aqueous extract. *Asian Pacific Journal of Tropical Disease, 3*(3), 189–191. https://doi.org/10.1016/S2222-1808(13)60038-9
9. Kahl, A., von Samson-Himmelstjerna, G., Krücken, J., & Ganter, M. (2021). Chronic wasting due to liver and rumen flukes in sheep. *Animals, 11*(2), Article 549. https://doi.org/10.3390/ani11020549
10. Kelley, J. M., Elliott, T. P., Beddoe, T., Anderson, G., Skuce, P., & Spithill, T. W. (2016). Current threat of triclabendazole resistance in *Fasciola hepatica*. *Trends in Parasitology, 32*(6), 458–469. https://doi.org/10.1016/j.pt.2016.03.002
11. Kumar, P., & Singh, D. K. (2014). In vitro anthelmintic activity of *Allium sativum*, *Ferula asafoetida*, *Syzygium aromaticum* and their active components against *Fasciola gigantica*. *Journal of Biology and Earth Sciences, 4*(1), B57–B65.

12. Mahendra, P., & Bisht, S. (2012). *Ferula asafoetida*: Traditional uses and pharmacological activity. *Pharmacognosy Reviews, 6*(12), 141–146. https://doi.org/10.4103/0973-7847.99948
13. Mamatkhanova, M. A., Khalilov, R. M., Kotenko, L. D., & Mamatkhanov, A. V. (2010). Izuchenie protsessa ekstraktsii summy slozhnykh efirov iz *Ferula kuhistanica* [Study of the extraction process of the sum of esters from *Ferula kuhistanica*]. *Uzbekskii Khimicheskii Zhurnal*, (1), 18–22.
14. Mamatkhanova, M. A., Khalilov, R. M., Syrov, V. N., Mamatkhanov, A. V., Kotenko, L. D., Sotimov, G. B., & Badrakhimov, Sh. N. (2009). Technology for cineroside production from the aerial part of *Ferula varia* and evaluation of its hypoazotemic activity. *Pharmaceutical Chemistry Journal, 43*(3), 160–162.
15. Najmitdinov, N. N., & Saidkhodzhaev, A. I. (2004). Terpenoidnye kumariny *Ferula botschantzevii* Korov. i *Ferula tersakensis* Korov. [Terpenoid coumarins of *Ferula botschantzevii* Korov. and *Ferula tersakensis* Korov.]. *Farmatsevticheskii Zhurnal*, (4), 19–20.
16. Niyozov, Kh. B., Eshmatov, F. Kh., & Yusupov, O. Sh. (2021). *Ferula nuratavica o‘simligining hayvonlar organizmiga va serpushtligiga ta’siri* [The effect of *Ferula nuratavica* on the animal organism and fertility]. Samarkand.
17. Pimenov, M. G. (1983). *Ferula* L. In *Opredelitel' rastenii Srednei Azii* [Key to the plants of Central Asia] (Vol. 7, pp. 276–313). Fan.
18. POWO. (n.d.). *Ferula kuhistanica* Korovin. Plants of the World Online. Royal Botanic Gardens, Kew. Retrieved August 22, 2026, from https://powo.science.kew.org
19. Rakhmonkulov, U. (1999). *Terpenoidsoderzhashchie rasteniya Zapadnogo Tyan'-Shanya i ikh ispol'zovanie* [Terpenoid-containing plants of the Western Tien Shan and their use] [Abstract of doctoral dissertation]. Tashkent.
20. Resolution No. PQ-251 of the President of the Republic of Uzbekistan of May 20, 2022, On measures to cultivate medicinal plants under cultivated conditions, process them, and organize their extensive use in treatment. https://lex.uz/docs/6027139
21. Resolution No. PQ-4670 of the President of the Republic of Uzbekistan of April 10, 2020, On measures to protect wild-growing medicinal plants, cultivate them under cultivated conditions, process them, and rationally use available resources. https://lex.uz/docs/4785256
22. Rojo-Vázquez, F. A., Meana, A., Valcárcel, F., & Martínez-Valladares, M. (2012). Update on trematode infections in sheep. *Veterinary Parasitology, 189*(1), 15–38. https://doi.org/10.1016/j.vetpar.2012.03.029
23. Tavassoli, M., Jalilzadeh-Amin, G., Fard, V. R. B., & Esfandiarpour, R. (2018). The in vitro effect of *Ferula asafoetida* and *Allium sativum* extracts on *Strongylus* spp. *Annals of Parasitology, 64*(1), 59–63. https://doi.org/10.17420/ap6401.133

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