Frankincense – the resin with healing power

medical Beauty Forum 2015 (4), 12-16

Frankincense ("Boswellia") has become rather important in various cultures and religions: the resilience of the tree growing in the Asian and African semi deserts is legendary and the tribal knowledge on the mystic and healing powers of its resin fills entire libraries. Today's science still appreciates its specific properties. What is it that makes frankincense so valuable?

Certainly not the excellent hot glue characteristics of the resin that already have been known in ancient times. In the German language, the clue is in the family name since boswellia belongs to the – literally translated – "balm tree family" or burseraceae (incense tree family): it supplies a balm.

Balms or balsams[1] are highly viscous herbal excretions. The non-aqueous liquids are rich in resins such as frankincense, benjamin (benzoin), myrrh and Peruvian balsam and contain

- essential oils,
- free acids,
- aromatic esters of the cinnamon and benzoic acids and aromatic aldehydes.

Ointments, oleogels and creams often are called balms today. In this context the term refers to an agreeably smelling and calming skin care product. The field of application of frankincense resin however is rather diversified and comprises

- dermatology and skin care,
- chronic inflammatory intestinal diseases,
- rheumatic diseases,
- respiratory diseases,
- tumours.

Accordingly, boswellia is integrated into ointments (topical, rectal), creams (topical), capsules (peroral), pills (peroral) and suppositories (rectal). The Indian frankincense has been included as a monograph in the European Pharmacopoeia (Ph. Eur.). The pharmaceutical term is olibanum. Despite of numerous in vitro and in vivo studies however not a single EU licensed frankincense-based conventional proprietary medicinal product is available on the market today.[2] In consequence of the above mentioned monograph however compounding pharmacies prepare individual extemporaneous formulations.
Boswellia resin extracts are used in extemporaneous formulations and in skin care as well as in the adjuvant corneotherapy[3] to treat skin disorders and support the prevention of skin disorders in the case of

- inflammatory skin reactions,
- sun erythema,
- radiations,
- acne,
- rosacea,
- perioral dermatitis,
- atopic skin and barrier disorders,
- actinic keratosis,
- psoriasis.

In this context now the ingredients, their effects, their content in specific frankincense qualities and their particular manufacturing are of interest. The main frankincense types are:

- Boswellia serrata ("Indian frankincense") occurs in India and is a component of the Ayurvedic folk medicine.
- Boswellia sacra ("Arabic frankincense") originates in Egypt, Somalia, Oman and Jemen. The characteristic smoke that forms when burning the incense is used in different religious bodies and communities to consecrate (German: "weihen") cult objects or cultic personnel which led to the German term "Weihrauch".
- Boswellia carteri is identical with boswellia sacra.

[1] H. Lautenschläger, Emotionsauslöser – Streifzug durch die Welt der Duftstoffe, Kosmetische Praxis 2010 (5), 10-14

[2] G. Meyer-Chlond, Ein fast vergessenes Heilmittel, Die PTA in der Apotheke 2011 (12), 26-27

[3] H. Lautenschläger, Grenzgänger – Kosmetische Hautpflege auf den Punkt gebracht, Beauty Forum 2010 (8), 27-29

The resin fraction of boswellia sacra respectively carteria is about 66% while boswellia serrata has about 56%.[4] The resins contain a multitude of components which vary depending on the origin and age of the respective trees. Hence it is somehow difficult to compare the results of the published medicinal and biochemical studies, the more so as the resins are used in the form of

- non-treated resins or
- resin extracts gained through different production and finishing processes, and as
- the implementation of in-vitro or in-vivo studies also varies.

Resin as an active agent

It is not unusual that effects and synergies somehow get lost when tracing the effects of a natural product – in this case the resins – via extracts and fractions up to the isolated singular substances. Also dose-response relationships may not necessarily have an explicit direction though. However there is broad consensus on the fact that the following resin acids have active agent characteristics.

- α- and β-boswellic acids as well their 3-position acetylated derivatives
- 3-acetyl-11-hydroxy-β-boswellic acid
- 11-keto-β-boswellic acid (KBA)
- 3-acetyl-11-keto-β-boswellic acid (AKBA)

The AKBA fraction in the resin of boswellia sacra with about 4% is the highest.[4] A non-acidic concomitant component is incensol. In-vitro, its acetate that only occurs in boswellia papyrifera[5] has anti-inflammatory features.
Boswellia extracts used in skin care frequently are standardized and contain up to 75% organic acids. Among them are 40% β-boswellic acid and 25% 3-acetyl-11-keto-β-boswellic acid. These extracts are largely free of the essential oils and mucilages of the original resins and hence only slightly, if at all, recall the originally balmy smelling frankincense.
While the resins, as already mentioned above, have distinct glue characteristics, the extracts frequently occur in powder form due to the high-molecular pentacyclic triterpene structures of the boswellic acids however are difficultly soluble. Both the preconditions are extremely disadvantageous for the preparation of acceptable skin care products with good haptic characteristics and effective dosage. Hence the cosmetic industry makes recourse to nanotechnological procedures:

- In the case of solid nanoparticles [6] [7] the powdery dry extracts are ground by means of milling and/or homogenizing procedures and then dispersed in watery media and stabilized with additives. Depending on the composition of the additives, the nanoparticles and their dispersions either are biodegradable or non-biodegradable.
- Liquid nanoparticles[8] are produced by means of high pressure homogenization from standardized extracts and phosphatidylcholine (PC), the main component of biological plasma membranes. They are biodegradable and fuse with the bilayers of the skin barrier from where the different components then are released in a controlled way.

The combination with phospholipids (lecithin) increases the oral availability of the extracts.[9] Since PC is effective against cornification disorders, the nanodispersions can also be administered for these indications. Nanodispersions can be applied on the skin either in pure form or in combination with lamellar but also PC containing base creams.

Anti-inflammatory substances

In dermal preparations 11-keto-β-boswellic acid (KBA) and 3-acetyl-11-keto-β-boswellic acid (AKBA) have anti-inflammatory effects

[4] B. Meier, J. Rethage, Olibanum indicum: indischer Weihrauch – eine Übersicht, Phytotherapie 2007 (1), 1-7

[5] M. Paul, J. Jauch, Efficient preparation of incensole and incensole acetate, and quantification of these bioactive diterpenes in Boswellia papyrifera by a RP-DAD-HPLC method, Nat Prod Commun. 7(3), 283-8 (2012)

[6] F. Shi, J. H. Zhao, Y. Liu, Z. Wang, Y.T. Zhang, N. P. Feng, Preparation and characterization of solid lipid nanoparticles loaded with frankincense and myrrh oil, Int. J. Nanomedicine 7, 2033-43 (2012)

[7] R. H. Müller, Historische Entwicklung und heutiger Stand der Technik von nanodispersen Formulierungen, Vortrag, 19. Jahrestagung der Gesellschaft für Dermopharmazie, Berlin 2015

[8] H. Lautenschläger, Biodegradable lamellar systems in skin care, skin protection and dermatology, SOFW-Journal 139 (8), 2-8 (2013)

[9] J. Hüsch, J. Bohnet, G. Fricker, C. Skarke, C. Artaria, G. Appendino, M. Schubert-Zsilavecz, M. Abdel-Tawab, Enhanced absorption of boswellic acids by a lecithin delivery form (Phytosome®) of Boswellia extract, Fitoterapia 84, 89-98 (2013)

which, among others, are ascribed to the inhibited 5-lipoxygenase measured in-vitro.[10] The enzyme is responsible for the formation of the inflammation-triggering leukotrienes. An influence on the prostaglandin E_2-synthesis has also been described. One of the reasons may be the thus inhibited cyclooxygenase-1 (COX-1) that otherwise leads to the formation of prostaglandins such as PGE_2 from arachidonic acid. Prostaglandin E_2 (PGE_2) in situ changes the permeability of vessels and thus causes skin redness, for instance.

It should however be mentioned that researchers more and more realize that the crucial anti-inflammatory activity of boswellia extracts results from the inhibition of various proteases. This theory, above all, explains the anti-inflammatory effect in the case of rosacea, psoriasis and photo damages such as sun burns and actinic keratosis. Analogously, also radiation damages caused during cancer therapies appertain to this category if the skin serves as a passage way. Representatives of these proteases are, above all, catepsin G and leucocyte elastase. Catepsin G, a serine protease, for instance can degrade matrix proteins such as elastin and collagen. Catepsin G is particularly inhibited by β-boswellic acid and by 3-acetyl-β-boswellic acid. [11]

The inhibition of proteases explains why boswellia nanodispersions are so effective in the skin care of the rosacea prone skin.[12] In the case of rosacea, serine proteases largely degrade the natural antimicrobial cathelicidins despite of their higher expressions. The antimicrobial protection is no longer sufficient and inflammations then form due to facultative pathogenic microorganisms of the skin flora and exogenous germs.

In the case of neurodermatitis, above all the structure forming filaggrins either are degraded by the pathogenic hyperactivity of proteases or insufficiently formed due to gene defects.[13] Proteases also are activated in the case of photo damages and then degrade the collagen structures. This is why boswellia containing preparations also are effective in the case of photo damaged skin.[14]

A further interesting observation in the context of the anti-inflammatory effect of boswellia resin acids is the inhibition of the NFκB-signaling pathway.[15] NFκB is a transcription factor which is activated in the case of inflammations and responsible for the immune response – hence also significant in the context of autoimmune diseases.

Conclusion

Boswellia resin extracts show a large variety of anti-inflammatory effects which have not yet been completely clarified. The biochemical relevance of the particular mechanisms still is controversially discussed. What is sure is that an indication-related skin care with appropriate preparations has led to significant results in practice.

Although the essential oils gained from the resins by water vapour distillation are responsible for the characteristic smell of the resins and contribute to the individual well-being, they do not have pharmacologically relevant effects from a present day perspective. They are processed into fragrance oils or aroma essences to be used in cosmetic preparations or aroma therapy. The origin of the resins is a crucial factor for the specific scent. The components mainly are low-molecular terpenes[16] and, as already mentioned at the beginning, aromatic esters and aldehydes.

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[16] H. Lautenschläger, Duftstoffe, Vitamine und Hormone – das ABC der Terpene, Beauty Forum 2010 (3), 56-58