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Review

Therapeutic potential of argan oil: a review

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Abstract

Objectives The therapeutic benefits of argan oil consumption have been claimed by natives of Morocco and explorers for more than eight centuries. However, argan oil has remained unresearched for a long time. Traditionally, argan oil has been well known for its cardioprotective properties and it is also used in the treatment of skin infections. Argan oil is principally composed of mono-unsaturated (up to 80%) and saturated (up to 20%) fatty acids. As minor components, it contains polyphenols, tocopherols, sterols, squalene, and triterpene alcohols. Together with the mono-unsaturated fatty acids, these minor components are likely to be responsible for its beneficial effects. This review aims to present an overview of the known pharmacological properties of argan oil.

Key findings Antiproliferative, antidiabetic, and cardiovascular-protective effects of argan oil have been particularly actively evaluated over the last 5 years in order to build on phytochemical studies that indicate the presence of large amounts of possibly pharmacologically active compounds.

Summary This review shows that a lack of clinical data constitutes a serious weakness in our knowledge about argan oil, therefore it is difficult to correlate the reported pharmacological activities to any potential clinical relevance.

Keywords *Argania spinosa*; edible oil; fatty acid; food supplement; tocopherol

Introduction

'Cold-pressed oils' and 'virgin oils' are two terms that can be confusing. Clarification was recently brought to this problem by Matthäus.[1] The term 'cold-pressed oil' can be used when a careful, gentle mechanical extraction of the raw material without application of heat is used. However, heat-treatment is allowed during preparation of the raw material and/or of the oil after the pressing process.

Following this definition, edible argan oil is a cold-pressed oil. It is prepared by pressing the slightly roasted kernels of the argan tree [*Argania spinosa* (L.) Skeels] fruit. *A. spinosa* is only endemic in south-western Morocco, where it covers an area of 3200 square miles that constitutes a unique biotope, named 'the argan forest'. In Morocco, the argan forest has an essential agro-economic function.[2] Because the argan tree is drought-resistant, it is also a powerful weapon for slowing down desertification.[3]

Sustainable development of the argan forest was initiated 15 years ago but its success was only recently ascertained.[4,5] The first step in this ambitious programme was the search for argan tree products possessing an economic value.

Cell-wall polymers of plants constitute the functional matrix that controls plant growth, development and interactions with biotic and abiotic environments. Some of these polymers have a cosmetic or nutraceutical value. Cell-wall polymers of *A. spinosa* leaves and fruit pulp include potentially valuable xyloglucans, galacturonans and pectins.[6–8] However, none of these compounds have yet been commercially exploited. Early phytochemical studies led to the identification of several saponins from *A. spinosa*.[9] The high saponin content of the trees was more recently confirmed.[10–12] Some of these saponins appear to have promising antiviral[13] or antioxidant[14] properties. Their introduction in cosmetic creams has also been commercially investigated.[15] Other metabolites from *A. spinosa* also have potential value in the cosmetic domain, and their industrial use is being actively investigated. In particular, its press-cake – the residue that remains after pressing the kernels – is a rich source of valuable proteins,[16] and its leaves contain high level of flavonoids (mainly quercetin and myricetin

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derivatives), which have potential uses in cosmetics.[17] The use of *A. spinosa* triterpenes is also being commercially evaluated.[18] Essential oils are also highly valuable derivatives, due to their pharmacological properties.[19–21] Essential oils contained in *A. spinosa* fruit pulp may also be of interest for use as an insect repellent.[22]

However, argan oil is by far the most valuable product derived from the argan tree. Its dietary and medicinal qualities are responsible for argan oil's important position in the oil market. Today, not only is argan oil quoted as 'the world's most expensive oil' but in 2009, it was ranked the number one cosmetic ingredient by Pierce Mattei, an important public relations firm working in the fashion and beauty area. For years, argan forest dwellers have claimed that argan oil is hepatoprotective and choleretic, that it prevents diabetes and that it has anti-inflammatory properties. Edible argan oil is therefore the basis of the 'amazigh diet'.[23] As a cosmetic, argan oil revitalises the skin, cures acne, hydrates dry skin, makes hair shine and so on. This review presents an overview of argan oil's medicinal properties as presently understood.

Chemical Constituents and Bioactive Compounds

Glycerides are the main chemical constituents of argan oil (up to 99%). Triglycerides compose not less than 95% of this fraction. The main fatty acids in these triglycerides are oleic and linoleic acids (47 ± 1% and 33 ± 3%, respectively), and two n-6 (omega-6) fatty acids.[24] There are also small amounts of saturated fatty acids in the triglycerides of argan oil: stearic acid (5.5 ± 1.5%) and palmitic acid (13.5 ± 1.5%).[24] For comparison purposes, the fatty acid content of some common and 'less common' oils[25,26] is reported in Table 1.

Minor components of argan oil include other organic derivatives such as (poly)phenols. Phenolic concentrations are very low,[27] but among those compounds unambiguously identified are vanillic acid, syringic acid, ferulic acid, tyrosol, catechol, resorcinol, (−)-epicatechin and (+)-catechin.[28–30] The presence of caffeic acid and oleuropein has been reported[31] but this finding has never been confirmed. Squalene, carotenes, triterpene alcohols (butyrospermol, tirucallol, β-amyrine, lupeol, 24-methylene cycloartanol, citrostadienol and cycloeucalenol), sterols (spinasterol, schottenol, stigma-8,22-dien-3β-ol (22*E*, 24*Z*), stigmasta-7,24-28-dien-3β -ol (24*Z*)), and α-, β-, γ- and δ-tocopherols (13%, 16%, 69% and 2%, respectively)[28,32] are other minor organic components of argan oil. There are also traces of inorganic elements (iron, copper, manganese and lead).[33]

The chemical composition of most of the edible vegetable oils is responsible for their favourable pharmacological profiles.[34] The particularly beneficial and healthful properties of argan oil have mainly been attributed to its specific polyphenol, squalene and tocopherol content.[28]

Unsaturated fatty acids are involved in several metabolic pathways, including chronic inflammation, a causative factor in a variety of cancers.[35] Although fatty acids belonging to the n-3 series are sometimes presented as the most efficient cardioprotectors, n-6 fatty acids are also essential in the composition of an equilibrated lipid diet.[36] Indeed, oleic acid is directly responsible for the reduction of blood pressure, through regulation of membrane lipid structure[37] and inhibition of the activity of gelatinase A (MMP-2),[38] an enzyme involved in cancer proliferation and Alzheimer's disease. Moreover, linoleic acid, the second major fatty acid of argan oil, is the metabolic precursor of arachidonic acid and its multiple bioactive eicosanoid derivatives.

Because of their free-radical scavenging and antioxidant properties, phenolic compounds and tocopherols also dramatically contribute to the beneficial pharmacological properties of argan oil. γ-Tocopherol is also known for its role in the primary prevention of heart disease[39] and possibly prostate cancer.[40]

Types of Oil

Traditional argan oil

The traditional process for argan oil extraction has already been reported in detail several times[2,3,32] and therefore will not be presented here. This is the type of oil that has been prepared for centuries by Moroccan women on a family scale. However, traditionally prepared argan oil chemical composition is poorly reproducible.[3] Such oil is generally of low quality and has a short shelf-life (Table 2).[41] For a single person, 2–2.5 l of oil are obtained from 100 kg of dry fruit after 58 h of work.

Cold-pressed argan oil

To produce large quantities of high-quality argan oil, women's cooperatives have been started in south-western Morocco.[2,42] In these cooperatives, argan oil is prepared by mechanically cold-pressing argan kernels. Using this technology, 4–6 l of oil can be obtained from 100 kg of dry fruit after 13 h of work by a single person.

Edible argan oil is prepared from roasted kernels, whereas unroasted kernels are used in the production of cosmetic argan oil (Table 2). The origin of the fruit and the processing method

Table 1 Percentage of oleic, linoleic, stearic and palmitic acid in common (corn, olive, soybean, sunflower and peanut) and less common (grape seed, argan) oils

Fatty acid	Corn oil	Olive oil	Soybean oil	Sunflower oil	Peanut oil[a]	Grape seed oil	Argan oil
Oleic	20–42.2	55–83	17.7–28	14–39.4	35–69	12–28	43–49.1
Linoleic	34–65.6	3.5–21	49.8–59	48.3–74	12–43	58–78	29.3–36
Stearic	<3.3	<5	2–5.4	2.7–6.5	1–4.5	<3.3	4.3–7.2
Palmitic	8.6–16.5	7.5–20	8–13.5	5–7.6	8–14	8.6–16.5	11.5–15

[a]Contains also behenic, arachidic and eicosenoic acids (1.5–4.5%, 1–2% and 0.7–1.7%, respectively).

Table 2 Differences between the four argan oil types

	Traditional oil	Cold-pressed edible oil	Cold-pressed cosmetic oil	Industrial cosmetic oil
Material	Uncontrolled fruit, roasted kernels	Hand-picked fruit, roasted kernels	Hand-picked fruit, unroasted kernels	Uncontrolled fruit, unroasted kernels
Process	Hand malaxing	Press	Press	Solvent
Preservation	One to two weeks	Several months	Up to one month	Several months
Colour	Yellow to brown	Copper-like	Gold-like	No colour
Taste	Not reproducible	Hazelnut like	Bitter	Not suitable as food
Quality	Low	Very high	Very high	Very high
Moisture	Variable	Low	Some amount	None
Antioxidants	Variable	High	High	None

used dramatically influence the quality of the argan oil produced.[43] Because of this, stringent preparation rules have been implemented in the cooperatives. These include the use of mechanical pressing in place of hand-pressing and mechanical fruit peeling. Also, the use of goat-digested argan nuts has been strictly outlawed, even though such a picking method was never general practice, as has sometimes been stated.[44] The polyphenol and tocopherol content of traditionally extracted and cold-pressed argan oils is similar. Their different shelf life is mainly due to the selection of the argan nuts and the frequent use of water of poor bacteriological quality during the traditional process.

Edible argan oil is also the major constituent of 'Amlou', a highly nutritive preparation whose composition also includes large quantities of crushed almonds and honey.

Cosmetic argan oil is directly used for skin application or as a hair lotion. It does not have the hazelnut taste of edible argan oil. Its content of volatile components is lower than that of edible argan oil[45] and its shelf life is also shorter, the latter extending up to 2 years, probably due to the formation during roasting of Maillard compounds, which favour preservation.[46]

Solvent-extracted argan oil

Industrially, cosmetic argan oil is prepared by solvent extraction of crushed argan kernels. No quality control is required for argan nuts (Table 2). Solvent-extracted argan oil, which is also sometimes flash distilled and deodorised, is used exclusively in the composition of creams, shampoos and body lotions. Preservatives are frequently added to compensate for the naturally protective agents lost during extraction and/or distillation (tocopherols, polyphenols etc.).

Human Health and Argan Oil Consumption

Argan oil has been used as a food and as a food ingredient, and has been applied to the skin for centuries, therefore its acute and chronic toxicity is assumed to be nil, particularly when orally administered at ordinary doses. Initially, argan oil's pharmacological properties have simply been deduced by consideration of the properties of its constituents, which have been isolated and pharmacologically evaluated, often in simple models. The chemical composition of argan oil has already been reviewed in detail,[32] and this aspect will therefore not be discussed here. Recently, scientific evaluation of the traditionally claimed benefits of argan oil consumption has begun, using animal models or cohort or clinical studies. These studies (Table 3) were aimed at determining if argan oil has only nutritional properties or if it can be said to also possess pharmacological properties.[65] Nevertheless, the general benefits indicated by some primary results have already triggered the preparation of argan oil-based emulsions for parenteral nutrition.[47]

Table 3 Key papers on the pharmacology of argan oil and their scientific findings

Reference	Keys papers and their scientific findings
Khallouki *et al.*[28]	Chemical composition of argan oil indicates its potential interest in preventing cancer
Bensouada[47]	Emulsion containing argan oil can be used for parenteral nutrition
Berrougui *et al.*[48]	Argan oil phenolic extract inhibits low-density lipoprotein oxidation and has hypolipemiant properties
Berrougui *et al.*[49]	Argan oil has hypolipidemic and hypocholesterolemic effects in rats
Drissi *et al.*[50]	Argan oil has hypolipemiant and antioxidant properties
Derouiche *et al.*[51]	Argan oil has an hypolipemiant effect in man
Berrougui *et al.*[52]	Argan oil lowers blood pressure in rats
Adlouni *et al.*[53]	Argan oil prevents obesity risk
Cherki *et al.*[54]	Argan oil presents an antiatherogenic effect in humans
Mekhfi *et al.*[55]	Argan oil inhibits platelet aggregation but has no influence on bleeding time
Bennani *et al.*[56]	Argan oil polyphenols and sterols have an antiproliferative effect on human prostate cancer cell lines
Bennani *et al.*[57]	Argan oil polyphenols have an antiproliferative effect on human prostate cancer cell lines
Drissi *et al.*[58]	Argan oil tocopherols have an antiproliferative effect on human prostate cancer cell lines
Samane *et al.*[59]	Argan oil has a potential interest as an antidiabetic
Bnouham *et al.*[60]	Antidiabetic activity of argan oil is confirmed
Samane *et al.*[61]	Argan oil is less efficient than fish oil to treat diabetes
Derouiche *et al.*[62]	Argan oil has no impact on thyroid hormone profile
Benzaria *et al.*[63]	Argan oil does not influence immune system
Astier *et al.*[64]	Argan oil triggers allergic reaction

Cancer chemoprotective effects

Because argan and olive oils share a similar composition, the cancer chemoprotective effect attributed to olive oil has also been attributed to argan oil.[28] Argan oil's high levels of γ-tocopherol – by far the most potent antioxidant of the tocopherols – and its high squalene content have even led to a suggestion that its chemoprotective effect may even be greater.[66]

Antioxidants present in argan oil[67] are believed to prevent or delay the onset of reactive oxygen species after lipid peroxidation observed in rats or human plasma.[48,49] Specific investigations on prostatic cells have shown that, *in vitro,* argan oil polyphenols and sterols have cytotoxic properties and exert an inhibitory effect on the proliferation of hormone-independent (DU145 and PC3) as well as of hormone-dependent (LNCaP) prostate cancer cell lines. The relative cytotoxic activity of argan oil polyphenols measured by means of the MTT assay indicates IC50 values of 75, 100 and 50 μg/ml for the DU145, LNCaP and PC3 cell lines, respectively.[56] For argan oil sterols, the IC50 values are 25, 75 and 70 μg/ml for the DU145, LNCaP and PC3 cell lines, respectively.[56]

In respect of cell proliferation, the calculated polyphenol concentrations inhibiting cell growth by 50% (GI50) at 24 h, in comparison with 2-methoxyestradiol, were 75, 100 and 50 μg/ml for the DU145, LNCaP and PC3 cell lines, respectively.[56] The sterol GI50s, in the same conditions, were 25, 75 and 70 μg/ml for the DU145, LNCaP and PC3 cell lines, respectively.[56] On the canine prostate cancer epithelial cell line (DPC-1), argan oil polyphenols showed a dose-dependent antiproliferative effect at an IC50 of 10 μg/ml.[57] However, only a weak antiproliferative effect was observed when argan oil polyphenols were evaluated on the SV40-immortalised human prostate epithelial cell line PNT1A.[57]

A cell cycle arrest mediated by up-regulation of the P27 cell cycle regulatory protein may explain the observed physiological activity of the tocopherols.[58] Large-scale epidemiologic studies using a γ-tocopherol-enriched diet have confirmed the beneficial effects of γ-tocopherol on prostate cancer prevention in humans.[40] Consequently, these results have encouraged the study of the antiproliferative effects of the polyphenol and sterol fractions of argan oil.

Inhibition of several enzymes, including ornithin decarboxylase, an enzyme highly expressed in prostate cancer, and NO synthase, or of the autophosphorylation of the epithelial growth factor receptor could explain the observed antiproliferative activity.[68] In an independent study, the antiproliferative effect of the squalene and polyphenol-rich unsaponifiable extract of argan oil on two cell lines (human HT-1080 fibrosarcoma and the transformed and invasive MSV-MDCK-inv cells) was clearly evidenced.[59] Using hepatoma tissue culture cells, it was shown that the squalene- and polyphenol-rich extract of argan oil reduces the ability of extracellular signal-regulated kinases 1 and 2 (ERK1/2) to respond to increasing doses of insulin.[59] Conversely, the response of the serine/threonine kinase (Akt), whose major function is to promote growth-factor-mediated cell survival and to block apoptosis response, remained undisturbed. Further in-vitro studies showed that argan oil polyphenols specifically interrupt the insulin-signalling cascades at the MEK1/2-ERK1/2 interface.[59]

Prevention of obesity and adverse cardiovascular outcomes

Hypercholesterolemia and platelet hyperactivity are associated with an increased risk of adverse cardiovascular outcomes (coronary artery disease, hypertension etc.). Phenolic compounds, phytosterols and tocopherols are well known as efficient hypocholesterolemic agents. Not surprisingly, argan oil's phenolic fraction prevents low-density lipoprotein (LDL) oxidation in isolated human plasma.[48] Phenolic compounds also enhance reverse cholesterol transport by increasing high-density lipoprotein (HDL) lipid-bilayer fluidity.[48] The presence of these derivatives is therefore commonly used to explain the anti-atherogenic potential of argan oil.[48]

Initially evidenced on rats,[49,52] the hypolipidemic and hypocholesterolemic potency of argan oil in humans has been demonstrated by mean of a cohort study on 60 men.[54] The effect was shown to be due to a paraoxonase-related improvement of the plasma oxidative status. The anti-atherogenic properties of argan oil have been evidenced by significant increases in paraoxonase activity and a decrease in lipoperoxide and conjugated diene formation.[54] Other complex pathways, initially resulting from an intracellular accumulation of squalene and ultimately triggering the liver X receptors,[69] may also explain argan oil's anti-atherogenic effects. A series of nutritional interventions has also shown that argan oil induces a lowering of LDL cholesterol and has antioxidant properties, as shown by a cohort study of 96 persons.[50] Here, subjects consuming argan oil on a regular basis presented significantly lower levels of plasma LDL cholesterol and lipoprotein (a) and lower concentrations of plasma lipoperoxides.[50] Argan oil also increases HDL cholesterol levels and lowers triglyceride levels in men,[51] therefore, and as might be expected, regular argan oil consumption has the potential to prevent obesity.[53]

Argan oil also inhibits platelet aggregation without causing either prolongation of bleeding time or a change in platelet levels.[55] *In vitro*, an inhibition of thrombin- or epinephrin-induced aggregation up to 50% was obtained at a dose of 0.5% of argan oil.[55] When rats were orally treated for 4 weeks with 10 ml/kg/day of argan oil, the thrombin-induced aggregation of isolated platelets was significantly inhibited (36%).[55] However, bleeding time remained unchanged,[55] therefore argan oil may act on the attachment of fibrinogen to GIIb/IIIa platelet receptor without affecting the adhesiveness of platelets to the vascular endothelium.[55] Together, these studies have led to argan oil consumption being recommended for the reduction of cardiovasuclar risk and the prevention of obesity, as has been traditionally claimed.[70]

Influence on thyroid hormone profile

Thyroid hormones and fatty acid metabolism are closely related. Unsaturated fatty acids have been shown to possibly prevent hypothyroidism.[71] The thyroidic activity of argan oil has been evaluated in a cohort study performed on 149 euthyroidic volunteers consuming non-iodised salt by measuring plasmatic concentrations of free tri-iodothyronine (FT3),

tetra-iodothyronine (FT4) and thyroid stimulating hormone. This study evidenced that no activity on hypothyroidism could be expected from argan oil dietary supplementation.[62]

Antidiabetic activity

The cardiovascular protective and antidiabetic effects of argan oil are the most longstanding claimed pharmacological effects of argan oil.[3] So far, however, the only scientific demonstration of a possible antidiabetic activity has been in rats.[60] Oral glucose test tolerance was performed on healthy or streptozotocin-induced diabetic rats. Intraperitoneal administration of argan oil (2.5 ml/kg) 30 min before oral glucose loading (1 g/kg) induced a significant glycemia reduction that lasted for 3 h.[60] Argan oil also significantly reduced the amount of absorbed glucose in perfused jejunum segment.[60] Samane *et al*. compared the metabolic response of rats to a free-access high-fat/high-sucrose diet in which 6% of the fat was replaced either by argan oil or fish oil. Intake of argan and fish oil resulted in the restoration of insulin signalling in fat and liver but fish oil also restored systemic insulin sensitivity.[61]

Influence on the immune system

Recent biochemical studies have shown that fatty acids may modify immune responses.[72] Indeed, lymphocyte proliferation, lymphocyte-derived cytokine production and cell-mediated immunity can all be influenced by dietary lipids. The effect of dietary argan oil on the immune system has been evaluated on rats.[63] These studies concluded that argan and olive oil's effects on immune cells are similar, and that argan oil has no marked effects on immune cell function.[63]

Anaphylaxis properties

The first, and so far unique, case of an allergy to argan oil has recently been presented.[64] Allergen was characterised as a 10 kDa protein, probably belonging to the family of oleosins that is also encountered in peanut and sesame.

Argan Oil Versus Other Edible Oils

The quality of an edible oil can be reflected in different factors. Among these, the most important are its sensory quality, its nutritional value and its pharmacological effect. If the sensory quality is important to get consumer acceptance and hence to occupy a reasonable market share, nutritional and pharmacological qualities are essential from a dietary standpoint.

In evaluating the nutritional quality of oil, fatty acid composition occupies a special place. More particularly, (poly)unsaturated fatty acids are essential nutrients, for they are the biological precursors of leukotrienes and prostaglandins, two types of compounds acting as hormone-like cell messengers. However, the simple presence of a high amount of linoleic acid does not necessary imply an oil of high nutritional value, as reported for grape seed oil.[73]

Olive oil is oleic acid-rich (Table 1). It is a globally used edible oil that is considered to be a key ingredient in the Mediterranean diet. Hence, its nutritional quality is recognised as high,[74] as are its unique biological properties.[75] Olive and argan oil contain high levels of oleic acid, with linoleic acid as the second major unsaturated fatty acid of each oil. The saturated fatty acids of both oils are palmitic and stearic acids, therefore the general nutritional qualities of olive and argan oils are likely to be identical. If only average values are considered, olive oil contains statistically higher values of monounsaturated fatty acid than argan oil. Argan oil is therefore nutritionally close to peanut oil, even though the latter contains small amounts of arachidic and behenic acids, saturated fatty acids that are not found in argan oil.[26] Nevertheless, this type of classification relies only on statistical analysis. The major difference between argan and olive oil is the large chemical variability tolerated for olive oil. Indeed, olive oil is produced in the whole Mediterranean basin and, because of its multiple geographic origins, olive oil fatty acid composition varies greatly. For example, its composition in linoleic acid can be either 3.5 or 21% and its level of oleic acid can be up to 83% but can be as low as 55%. Since consumers are not necessarily aware of the geographical origin of the olive oil they purchase, they cannot be certain of the precise nutritional value of any particular olive oil. In contrast, argan oil fatty acid composition is much more homogenous and, consequently, its nutritional value is less variable.

Variation in the geographic origin of edible oils also dramatically affects the proportions of the minor oil components. These oils also contribute to the pharmacological quality of the oil. Several of olive oil's minor components (polyphenols, sterols, tocopherols etc.) have been presented as responsible for the oil's pharmacological properties,[75] but large variations have also been observed in terms of concentration, suggesting that not all olive oils have the same pharmacological potential.[76] Again, the minor component profile of argan oil has little variation and is likely to be responsible for a more reproducible pharmacological profile.

Argan Oil as a Food Supplement

Argan oil's specific taste and its claimed pharmacological properties are at the origin of the culinary and medicinal interest directed at this oil in the last 10 years. The benefits for the elderly of a long-term diet rich in argan oil are currently being evaluated. Even slightly encouraging results could rapidly lead to argan oil gaining a place in the lucrative food supplement field.

However, quality matters could prevent this happening. Because of the elevated price of argan oil and since there are many other vegetable oils on the market, adulteration of argan oil is a risk. To prevent this fraudulent behaviour, simple analytical methods have been designed to unambiguously distinguish argan oil from other oils, based on the presence of a marker in low quantity oils.[77] Argan oil's recently granted status as a product of protected geographic indication is also going to be an efficient means to control its sensory, nutritional and pharmacological quality. Processing parameters as simple as argan kernel storage conditions influence oil quality and levels of minor components,[78] therefore each processing parameter is currently being investigated. Optimum parameters will become mandatory after inclusion in the geographic indication file in order to maintain argan oil's chemical and pharmacological quality.

Conclusions

This review shows that while the chemistry and a few pharmacological aspects of argan oil have been studied, there are still no strong clinical data available that provide evidence of the efficacy of argan oil in humans. That argan oil constituents have pharmacological properties *in vitro* is not sufficient to ascertain the clinical potential of whole argan oil. More studies are necessary to determine its impact on human health. Considering the elevated price of argan oil, these studies should be aimed at demonstrating the intrinsic as well as relative efficacy of argan oil compared to other oils. Interestingly, the position of argan oil as a natural product with strong consumer expectations resulting from traditional claims of activity that are insufficiently supported by scientific proof is shared by several other plant extracts or products.[79,80] Such a trend is likely to continue in view of the strong current demand for food supplements. This demand justifies pharmacological studies on these products.

Declarations

Conflict of interest

The Author(s) declare(s) that they have no conflicts of interest to disclose.

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