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Purple Nutsedge vs Tooth Decay

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Ancient People Achieved Remarkably Clean Teeth With Noxious Weed?

The purple nutsedge is one of the world's worst weeds, spreading stealthily underground and shrugging off herbicides as if they were soda water. But new research shows that for one ancient people, this noxious plant may have served as a tooth cleaner.

A new analysis of skeletons reveals that people who lived in Sudan 2,000 years ago were eating the purple nutsedge. Those people had surprisingly sound teeth — and the antibacterial properties of the weed may deserve the credit, scientists say in a study published in the journal PLOS ONE on Wednesday.

Early humans generally had relatively few cavities, thanks in part to meals that were heavy on the meat, light on the carbs.

Then humans invented farming and began eating more grain. Bacteria in the human mouth flourished, pouring out acids that eat away at the teeth. The first farmers tended to have much more tooth decay than hunter-gatherers did.

But when scientists looked at the teeth of people buried roughly 2,000 years ago in an ancient cemetery called Al Khiday 2, they found that fewer than one percent of the teeth had cavities, abscesses, or other signs of tooth decay, though those people were probably farmers, says study co-author Donatella Usai of Italy's Center for Sudanese and Sub-Saharan Studies.

Analysis of hardened bits of plaque on the teeth showed those interred at the cemetery had ingested the tubers of the purple nutsedge, perhaps as food, perhaps as medicine. People buried at Al Khiday at least 8,700 years ago — before the rise of farming there — also consumed the tubers, probably as food.

Experiments by other researchers show that extracts of the weed impede the growth of the bacteria most widely implicated in tooth decay. So the weed could have served as both a nutritious dinner and a primitive, if unintentional, antibacterial potion, the scientists say, though they caution that they haven't proved a link.

Such a function is certainly possible, says biological anthropologist Sarah Lacy of the University of Missouri-St. Louis, who is not associated with the new study. No other example has been reported of a specific plant that kept tooth decay in check among ancient people, says Lacy, who calls the results "very exciting."

The purple nutsedge tuber may have many virtues, but a nice flavor isn't one of them. People might have tried to tame the tubers' bitterness by cooking them, says study co-author Karen Hardy of the Catalan Institution for Research and Advanced Studies at the Autonomous University of Barcelona, or they may have just tolerated the bad taste.

"They might have been using it for some medicinal purpose," Hardy says. "Medicine always tastes horrible, so it would be par for the course."

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[Excerpts]

Dental Calculus Reveals Unique Insights into Food Items, Cooking and Plant Processing in Prehistoric Central Sudan

Stephen Buckley, et al.

Abstract

Accessing information on plant consumption before the adoption of agriculture is challenging. However, there is growing evidence for use of locally available wild plants from an increasing number of pre-agrarian sites, suggesting broad ecological knowledge. The extraction of chemical compounds and microfossils from dental calculus removed from ancient teeth offers an entirely new perspective on dietary reconstruction, as it provides empirical results on material that is already in the mouth. Here we present a suite of results from the multi-period Central Sudanese site of Al Khiday. We demonstrate the ingestion in both pre-agricultural and agricultural periods of Cyperus rotundus tubers. This plant is a good source of carbohydrates and has many useful medicinal and aromatic qualities, though today it is considered to be the world's most costly weed. Its ability to inhibit Streptococcus mutans may have contributed to the unexpectedly low level of caries found in the agricultural population. Other evidence extracted from the dental calculus includes smoke inhalation, dry (roasting) and wet (heating in water) cooking, a second plant possibly from the Triticaceae tribe and plant fibres suggestive of raw material preparation through chewing.

The identification of chemical compounds and identifiable microfossils from dental calculus extracted from archaeological skeletons is providing new insights into dietary composition and biographical detail. These new insights are proving to be useful in accessing evidence for ingested plants, particularly in pre-agrarian periods for which evidence of plant use is rare. Stable isotope analysis has been used extensively to investigate pre-agrarian dietary composition [1] [2]. It provides non-specific identification, principally of primary protein sources, but offers little information on dietary plant sources. Carbon isotope analyses differentiate between C3 and C4 plants, but provide little insight into what the actual plants were. The extraction of chemical compounds and microfossils from dental calculus offers an entirely new perspective on dietary reconstruction. Because of its location within the mouth, dental calculus offers a direct link to material that was inhaled or ingested and its value as a source of biographical information for past human populations has recently become evident in terms of microfossils [3] [4] [5] [6], chemical compounds [7], and as a source of bacterial DNA [8]. Here we offer the results of a combined analytical and morphological analysis of the material extracted from samples of dental calculus from the multi period site of Al Khiday, Sudan. This has enabled us to identify specific food items, inhaled micro-environmental data and the use of teeth for processing plant-based raw materials. The material from Al Khiday is of particular interest as it is a multi-period cemetery. This permits a long-term perspective on the material recovered. Indeed, one of the original aims of this study was to evaluate the limits of survival of both chemical compounds and microfossils given the extreme climate of the Sahara; however, no difference in survival or degradation of materials was encountered through the sequence.

Dental calculus occurs when plaque biofilms accumulate and mineralize. It is associated with chronically poor oral hygiene and is common on archaeological skeletons of all periods. Dental calculus is found around the teeth in the supragingival and subgingival areas and is linked to high levels of carbohydrate consumption due to the sugars that are eventually converted into glucose. Subgingival calculus, which has been identified on material several million years old [9], occurs below the gum-line in the gingival crevice. Subgingival calculus is particularly useful for analysis as it can accumulate and endure indefinitely if it is not mechanically removed [10]. Microbial communities in subgingival calculus are proteolytic rather than sacchrolytic. The metabolic by-products of proteolytic metabolism, such as ammonia, result in localized raised pH. This in turn encourages plaque mineralization as precipitation of calcium phosphate is favoured.

Al Khiday is a complex of five archaeological sites which lie 25 kilometres south of Omdurman, on the White Nile, in Central Sudan. Al Khiday 2 is predominantly a burial ground of pre-Mesolithic, Neolithic and Late Meroitic age though it was also used as an occupation site during the Mesolithic period (Figure 1) [11]. The Mesolithic phase is represented by 104 pits which include fireplaces and disposal areas containing Mesolithic material. Although the pre-Mesolithic human remains cannot be directly dated due to insufficient collagen and bio-apatite which have been replaced by environmental carbonatic formations, their graves are cut by the creation of these pits during the Mesolithic which provide a Terminus ante quem of 6700 cal. BC [11]. The Neolithic and Meroitic skeletons were dated using charcoal and shells found in the graves [11]. The period covered by these samples stretches from the pre-agricultural fisher-hunter-gatherer based economy through the early Neolithic with its incipient agriculture, and on to the fully developed agricultural context of the Meroitic...

The chemical evidence for C. rotundus is most clearly demonstrated in the Meroitic burial 74 (Figure 3) with the identification of a number of characteristic mono- and sesquiterpenoids, including norrotundene and rotundene (Figure 3b) (Information S1. Methods and TD/Py-GC-MS detailed results, Table 2), which were present in minor abundance, these same terpenoids having been previously identified in minor to moderate abundance in the essential oil of the C. rotundus rhizome/tuber [23] [24] (Information S1. Methods and TD/Py-GC-MS detailed results). These minor C. rotundus components were not detected in burials 10-I, 103 due to the relatively small amount of organic material present in these samples (Figure 3a). Although calamene, calamenene and cadalene, identified as significant components in these samples, are known to be constituents of the essential oil of fresh C. rotundus rhizome/tuber, their potential origin as diagenetic products from other more labile sequiterpenoids such as cadinenes must also be considered. However, the presence of calarene (ß-gurjunene) in all four samples, which would not be a product of diagenesis and is known to be present in the essential oil component of C. rotundus in minor to moderate abundance [23] [24] (Information S1. Methods and TD/Py-GC-MS detailed results), together with the suite of monoterpenoid and sesquiterpenoids identified in the calculus samples and previously observed in the rhizomes/tubers of C. rotundus [22] [23] [24] (Information S1. Methods and TD/Py-GC-MS detailed results), is indicative of this plant species in these samples. It should also be noted that the lack of oxygenated mono- and sesquiterpenoids normally present in C. rotundus reflects the bio-transformations in the mouth as a result of human oral bacteria [7]. Notably, dialkyl branched alkanes were identified in samples 35, 10-I, 103 and 74, dominated by the 5,5-diethylalkanes, in addition to lesser amounts of 3,3-diethyl-, 3-ethyl-3-methyl, 5,5-dibutyl-, 5-butyl-5-ethyl- and 6,6-dibutyl-alkanes [24] (Figure 3) (Information S1. Methods and TD/Py-GC-MS detailed results). These methyl, ethyl and butyl branched alkanes of C15 to C23 are indicative of microorganisms [24] [25] (Information S1. Methods and TD/Py-GC-MS detailed results). Their association with the C. rotundus terpenoids, combined with the information outlined above suggests that they most likely derive from a microorganism associated with the tubers and rhizomes, or the immediate environment in which they grew.

Given the chemical evidence for ingestion of C. rotundus, the starch granules were compared to modern C. rotundus L. reference material. There is a tentative morphological correlation between the modern reference material and the starch granules in the pre-Mesolithic samples, though modern examples from the Near East appear more rounded and lack fissures emerging from the hilum. Identification of the botanical origin of starch granules is challenging, however. The general morphology of the type 1 granules is also reminiscent of starch granules found in certain tribes of the Poaceae family, such as Paniceae and Andropogoneae [26]. For example some species of the genus Setaria have starch granules that are morphologically similar with a fissured hilum, often stellate, though slightly smaller. A large number of species of these tribes are gathered still today in many regions of Africa [27]. It is therefore currently not possible, to provide a secure provenance for these starch granules...

Cyperus rotundus is particularly interesting as it is present in all periods. C.rotundus or ‘purple nut sedge’ is a C4 plant that is profligate in moist tropical environments. It has been called the ‘world’s most expensive weed’ [39] due to its ability to spread rapidly through its underground storage system of bulbs, rhizomes and tubers, whose proliferation may be caused by an excess of carbohydrates [40]. C. rotundus was highlighted as a potentially key component of the diet of the Late Palaeolithic population of Wadi Kubbaniya in southern Egypt (17,000–15,000 BC) 1000 km north of Al Khiday, where it predominated in the abundant assemblages of charred plant remains [41]. However, despite identification of several plant species in charred human coprolites, C. rotundus was not detected [41].

Chewing, followed by expulsion of pithy quid, is common among traditional tuber-eaters such as the Hadza [42] even after these have been cooked [43]. C. rotundus tubers can be pithy and expelling the quid after chewing may explain why no physical evidence for C. rotundus was found in the coprolites at Wadi Kubbaniya despite the abundant carbonised remains.

The use of C. rotundus as a carbohydrate staple is documented across tropical regions among recent hunter-gatherers and as a famine food in some agrarian societies; its nutritional value is enhanced by the presence of lysine, an essential amino acid [41]. C. rotundus has also been considered as part of a package of high starch, tuber-rich sedges that may have been exploited by Pliocene hominins [44] [45]. Though today it is considered to have a bitter taste [41], C. rotundus was one of three tuber staples among Aboriginal populations in Central Australia [46]. While the tubers can be small and time-consuming to harvest, experimental harvesting recovered over 21,000 tubers per m2 in permanently wet environments; in drier areas, although the quantity decreased, tuber size increased and bitterness was diminished [41]. The availability of other, possibly better tasting C3 plants, most likely cultivated crops, in the Neolithic and Meroitic periods begs the question of why C. rotundus continued to be ingested.

In addition to its value as a source of carbohydrates, C. rotundus, has many other qualities that have been widely recognised. Numerous accounts of the non-nutritional use of C. rotundus from ancient Egypt [47], Mycenean Greece [48] and elsewhere exist, including its use for aromatic purposes and in water purification [41]. C. rotundus is mentioned by the Hippocratic doctors (5th century BC), Theophrastus, Pliny and Dioscorides (1st century AD), as a source of perfume and medicine [49]. Dioscorides also highlights the use of C. rotundus tubers as an ingredient of ancient Egypt's best known perfume, kuphi or kyphi, an incense that also had medicinal properties and provides a preparation to perfume goose or pork fat made by mixing C. rotundus with other vegetable agents [49]. A wide range of medicinal uses have been recorded [22] [50] [51] [52] [53] [54] [55] and anti-microbial [56] [57], anti-malarial [58], anti-oxidant [59] [60] [61] [62] and anti-diabetic [63] compounds have been isolated and identified. Tubers are still used today in herbal medicine in the Middle East, Far East and India [48], for perfume and animal fodder [51] [64] and as incense in Burkina Faso [65].

C. rotundus tubers are very likely to have been eaten principally for their nutritious qualities during pre-Mesolithic periods; however, their continued use in agricultural periods suggests they may also have been used for other purposes, instead of, or in addition to their value as a nutritional resource. Though the ingestion of plants specifically for medicinal purposes is now accepted among higher primates [66], demonstrating similar behaviour among early human populations is challenging [7] [67]. However, the non-nutritional qualities of C. rotundus suggest that it could have been appreciated for its aromatic or medicinal qualities in addition to its potential value as a lean period or fall-back food.

The development of dental caries is strongly associated with diet, most notably the presence of sugars including fermentable carbohydrates which interact with plaque bacteria to cause demineralisation; the presence of caries also increases with age (68). At the late Palaeolithic site in Taforalt, Morocco [69] a link has been made between specific highly starchy cariogenic foodstuffs found at this site, the time period of expansion of Streptococcus mutans which is a leading contributor of tooth decay today, and the unexpectedly high prevalence of caries in teeth, to suggest that the food items ingested caused the high caries rate found in the population here. Laboratory testing of C. rotundus extract has demonstrated that this inhibits S. mutans [70] [71]. As the type of food ingested can have a direct effect on the health of teeth (68), we suggest that chewing C. rotundus tubers may have contributed to the unexpectedly low prevalence of dental caries in the Meroitic samples at Al Khiday and possibly also Gabati...

Biomolecular studies of dental calculus are highly challenging, as the organic material entrapped is variable and the quantities are often small, yet despite this, the study presented here has not only detected and identified a wide range of organic compounds in the samples analysed, but has also permitted the identification of C. rotundus. These results highlight the potential for future biomolecular studies which complement ongoing research focussed on the more labile biomolecule of DNA...

The extensive evidence extracted from the dental calculus for the ingestion and working of plants, as well as the use of C. rotundus tubers as a source of carbohydrates and possibly as medicine or as flavouring, fits well within the perspective of broad environmental and ecological knowledge in prehistoric periods. Today, Cyperus rotundus is used as animal fodder and is considered the world's most costly weed as its prolific tubers spread underground, but while its tenacity and prolificity is problematic for farmers now[39] [40], these qualities made it an abundant and accessible resource in the past.

The development of studies on chemical compounds and microfossils extracted from dental calculus will help to counterbalance the dominant focus on meat and protein that has been a feature of pre-agricultural dietary interpretation, up until now The new access to plants ingested, which is provided by dental calculus analysis, will increase, if not revolutionise, the perception of ecological knowledge and use of plants among earlier prehistoric and pre-agrarian populations.

Supporting Information

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Chemical study of the essential oil of Cyperus rotundus

Mesmin Mekem Sonwa, Wilfried A König,

Abstract

Minor constituents of the essential oil of Cyperus rotundus have been investigated. The three new sesquiterpene hydrocarbons (-)-isorotundene, (-)-cypera-2,4(15)-diene, (-)-norrotundene and the ketone (+)-cyperadione were isolated and their structures elucidated. The absolute configuration of (-)-rotundene was derived by chemical correlation and enantioselective gas chromatography.

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Wound healing activity of cyperus rotundus linn.

A Puratchikody, C Nithya Devi, G Nagalakshmi

Abstract

The present study was aimed to evaluate the wound healing activity of extract of tuber parts of Cyperus rotundus . It is a well-known plant in Indian traditional medicine. On the basis of traditional use and literature references, this plant was selected for evaluation of wound healing potential. An alcoholic extract of tuber parts of Cyperus rotundus was examined for wound healing activity in the form of ointment in three types of wound models on rats: the excision, the incision and dead space wound model. The extract ointments showed considerable difference in response in all the above said wound models as comparable to those of a standard drug nitrofurazone ointment (0.2% w/w NFZ) in terms of wound contracting ability, wound closure time and tensile strength.

Wound may be defined as a loss or breaking of cellular and anatomic or functional continuity of living tissue[1]. Wound healing is a complex phenomenon involving a number of processes, including induction of an acute inflammatory process, regeneration of parenchymal inflammatory process[2], migration and proliferation of both parenchymal and connective tissue cells, synthesis of extracellular matrix (ECM) proteins, remodelling of connective tissue and parenchymal components, and acquisition of wound strength[3]. All these steps are orchestrated in a controlled manner by a variety of cytokines including growth factors[4]. Some of these growth factors like platelet-derived growth factor B (PDGF), transforming growth factor B (TGF-B), fibroblast growth factor (FGF) and epidermal growth factor (EGF) have been identified in self-healing wounds[2]. In chronic wounds, the normal healing process is disrupted due to some unknown reasons, and in such cases, exogenous application of certain growth-promoting agents or compounds which can enhance the in situ generation of these growth factors is required to augment the healing process. Several factors delay or reduce wound healing, including bacterial infection, necrotic tissue, interference with blood supply, lymphatic blockage and diabetes mellitus. Generally if the above factors could be inhibited/controlled by any agent, increasing healing rate could be achieved[5].

Cyperus rotundus Linn. (Family Cyperaceae), commonly known as mustaka, is a pestiferous perennial weed with dark green glabrous culms, arising from a system of underground tubers found throughout India[6],[7]. The tubers are useful as infusion or as a soup in fever, diarrhoea, dysentery, dyspepsia, vomiting and cholera. Fresh tubers are applied on the breast in the form of paste or plaster as galactagogue. Paste is applied to scorpion stings and when dried, to spreading ulcers[7]. The acetone and ethanol extracts of tubers were found to possess anti-bacterial activity[8]. It is one of the plants mentioned in the literature having claims of activity against liver disorders[9]. The tubers of the plant are used as anthelmintic, antihistaminic, antiemetic, antipyretic, hypotensive, smooth-muscle relaxant and emmenagogue in uterine complaints[10]. The plant has also been reported to have antimalarial, tranquillizing, hepatoprotective against carbon tetrachloride induced liver damage, lipolytic action and reduced obesity by releasing enhanced concentration of biogenic amines from nerve terminals of the brain, which suppressed the appetite centre[11]. The plant has also been reported to have antimalarial, tranquillizing action as well as hepatoprotective action against carbon tetrachloride induced liver damage. It is said to have lipolytic action and also property that helps reduce obesity by releasing enhanced concentration of biogenic amines from nerve terminals of the brain that suppress the appetite centre[11]. It is also reported to have anti-inflammatory activity [12].

It contains a wide variety of phytoconstituents that are useful in the treatment of different ailments and includes sesquiterpene 4a-, 5a-, oxidoeudesm-11-en-3a-ol, cyperene-1 (a tricyclic sesquiterpene), cyperene-2 (a bicyclic sesquesterpene hydrocarbon), cyperenone, and a-cyperone[12], mustakone (a new sesquesterpene ketone), ß -selinene, sugetriol triacetate (a new sesquesterpenoid), sugenol (sesquesterpenic ketol)[13]; the essential oil including copadiene, epoxyguaiene rotundone, cyperenol, cyperolone, eugenol, cyperol, isocyperol, a-and ß -rotunol, kobusone, isokobusone[12], d-cadinene and calamenone; a flavonol glycoside, rhamnetin 3-O-rhamnosyl-(1®4) rhamnopyranoside and ß -sitosterol[11]. A survey of literature reveals that no systematic approach has been made to study the wound healing activity of tubers of this plant. In the present work, we have investigated the wound healing activity of the ethanol extract of Cyperus rotundus in an ointment form.

Fresh rhizomes of Cyperus rotundus Linn. were collected from Namakkal District, Tamilnadu, during the months of May-June 2003. The identity of the tubers has been confirmed by using all official monographic specifications[14]. Tubers were dried under shade, pulverised by a mechanical grinder and passed through a 40 mesh and then stored in a well-closed container for further use.

The powdered tubers (500 g) were extracted with ethanol (90% w/v) for 24 h using a Soxhlet extractor. This ethanol extract was concentrated to dryness under reduced pressure and controlled temperature (50-60o) to yield solid masses that were completely free from solvents (12.3%). The different concentrations (0.5, 1 and 2% w/w) of extract ointment were prepared using simple ointment base BP[15].

Male Wistar rats (150-180 g) were selected for the present investigation. The animals were maintained at a well-ventilated, temperature-controlled (30±1o) animal room for 7 d prior to the experimental period. The animals were provided with food and water ad libitum. The animals were divided into six groups of six rats each as follows: Group I rats were treated with simple ointment base (control). Group-II rats were treated with a reference standard 0.2% w/w nitrofurazone (NFZ) ointment. Group III, IV and V rats were treated with 0.5, 1 and 2% w/w of extract ointments respectively. The extract ointments (0.5, 1 and 2% w/w) at a quantity of 0.5 g were applied once daily to treat different groups of animals. The simple ointment base and 0.2% w/w NFZ ointment were applied in the same quantity to serve as control and standard respectively. Before performing these experiments, ethical clearance was obtained from Institutional Animal Ethics Committee (CPCSEA Registration No. 418).

In the excision wound model[16],[17],[18], the full-thickness excision wounds were made on the rats by removing a 500 mm2 piece of skin from the depilated backs after being anaesthetized with anaesthetic ether by the open-mask method. After skin excision, the wound was left open to the environment. Male Wistar rats (150-180 g) were used in this study and worked-up as above. The groups were treated in the same manner as mentioned in the animal experimentation. Wound healing potential was monitored by wound contraction and wound closure time [Table - 1]. Wound contraction was calculated as percentage reduction in wound area [Figure - 1]. The progressive changes in wound area were monitored planimetrically by tracing the wound margin on graph paper on wounding day, followed by 6th, 12th and 18th day.

For the incision wound model[19],[20],[21], the animals in each group were anaesthetized with anaesthetic ether, and two paravertebral long incisions of 6 cm length were made through the skin and cutaneous muscles at a distance of about 1.5 cm from the midline on each side of the depilated back of the rats. After the incision was made, the parted skin was kept together and stitched at 0.5 cm intervals continuously and tightly using surgical thread (No. 000) and a curved needle (No.11). All the groups were treated in the same manner as mentioned in the case of excision wound model. Extract ointments, simple ointment base (control), and standard drug were applied once daily for 9 d. When the wounds were cured thoroughly, the sutures were removed on day 9 and the tensile strength of the healed wound was measured on day 10 by continuous and constant water flow technique by the method of Lee [Table - 1][22],[23].

Physical changes in the granuloma tissue were studied in this model. Under light ether anaesthesia, in the rats, subcutaneous dead space wounds were inflicted in the region of the axilla and groin by making a pouch through a small nick in the skin.[24] Granuloma formation was induced by implanting grass piths in those regions. Cylindrical grass pith measuring 2.5 cm in length and 0.3 cm in diameter was introduced into the pouch. The wounds were sutured and mopped with alcoholic swabs. Animals were placed into their individual cages after recovery from anaesthesia. Excision of the granulomas from the surrounding tissues were performed on the 10th post-wounding day under light ether anaesthesia. Granuloma surrounding the grass piths were excised and slit open. The tensile strength of the piece measuring about 15 mm in length and 8 mm in width (obtained by trimming the rectangular strip of granuloma tissue) was determined on the 10th post-wounding day by adopting continuous water flow technique of Lee[22],[23]. The buffer extract of the wet granuloma tissue was used for the determination of tensile strength[25]. The results are expressed as mean±SEM and statistical significance was evaluated zby using Student's t test Vs control group. $P < 0.001$ implies significance[26].

The effect of extract ointments, NFZ ointment (standard) and simple ointment base (control) in the excision wound model and in the incision wound model were assessed by measuring the wound area and tensile strength respectively. The data including wound area (mm 2) and tensile strength of healed wound was furnished in [Table - 1]. The present investigation revealed that the test extract in varying concentrations in the ointment base were capable of producing significant wound healing activity on both wound models. The entire test extract ointments used in excision wound model showed significant wound healing effect on days 12 and 18. The results in [Table - 1] indicate that out of the three extract ointments used in the experiment, ointment prepared with 2% w/w of alcoholic extract of Cyperus rotundus has been found to have relatively more wound healing activity with 100% of wound closure on day 18 as compared to the standard NFZ. A considerable difference in response between the two extract ointments (0.5 and 1% w/w) was noted on wound closure. The percentage wound contraction is shown in [Figure - 1]. In the incision wound studies, there was a significant increase in tensile strength on day 10 due to treatment with either the extract ointments or the standard NFZ when compared to control. The effect produced by the NFZ ointment (0.2% w/w) application was found to be same as that obtained with the application of the extract ointment (2% w/w) [Table 1].

The results of dead space wound model are given in [Table - 2]. The tensile strengths of the granuloma tissues were determined by water-flow technique of Lee[22],[23]. Extract ointment (1% w/w and 2% w/w) were found to enhance the tensile strength as compared to the control group ($P < 0.001$). The relative distribution of cells, collagen fibres and vessels in different parts of the 10-day-old granulation tissue in inner and outer zone of control group, 1% and 2% w/w extract ointment is shown in [Figure - 2] [Figure - 3][Figure - 4][Figure - 5], respectively. In this wound model, the increase in tensile strength of treated wound may be due to increase in collagen concentration/unit area and stabilisation of the fibres[27].

This plant is previously reported to possess anti-inflammatory activity and used in spreading ulcers. The process of wound healing occurs in four phases: (i) coagulation, which prevents blood loss, (ii) inflammation and debridement of wound, (iii) repair, including cellular proliferation, and (iv) tissue remodelling and collagen deposition[28]. Any agent that accelerates the above process is a promoter of wound healing, due to the presence of active terpenes[29], flavonol glycosides[30],[31] and ß -sitosterol in tuber part of Cyperus rotundus . This may be effective in reducing tissue swelling, and oozing of tissue fluids accompanying inflammation revealed a positive healing profile.

The wound healing property of Cyperus rotundus appears to be due to the presence of its active principles, which accelerates the healing process and confers breaking strength to the healed wound. On the basis of the results obtained in the present investigation, it is possible to conclude that the ointment of the extract of Cyperus rotundus has significant wound healing activity at all the doses tested.

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http://www.sciencedirect.com/science/article/pii/S0367326X05002352

Antidiarrhoeal activity of Cyperus rotundus

S.J. Uddina, et al.

Abstract

The methanol extract of Cyperus rotundus rhizome, given orally at the doses of 250 and 500 mg/kg b.w., showed significant antidiarrhoeal activity in castor oil induced diarrhoea in mice. Among the fractions, tested at 250 mg/kg, the petroleum ether fraction (PEF) and residual methanol fraction (RMF) were found to retain the activity, the latter being more active as compared to the control. The ethyl acetate fraction (EAF) did not show any antidiarrhoeal activity.

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http://www.sciencedirect.com/science/article/pii/S1382668905001031
Environmental Toxicology and Pharmacology, Volume 20, Issue 3, November 2005, Pages 478–484

Investigation of extracts from (Tunisian) Cyperus rotundus as antimutagens and radical scavengers

Soumaya Kilania, et al.

Abstract

This study evaluates mutagenic and antimutagenic effects of aqueous, total oligomers flavonoïds (TOF), ethyl acetate and methanol extracts from aerial parts of Cyperus rotundus with the Salmonella typhimurium assay system.

The different extracts showed no mutagenicity when tested with Salmonella typhimurium strains TA98, TA100, TA1535 and TA1538 either with or without the S9 mix. On the other hand, our results showed that all extracts have antimutagenic activity against Aflatoxin B1 (AFB1) in TA100 and TA98 assay system, and against sodium azide in TA100 and TA1535 assay system. TOF, ethyl acetate and methanol extracts exhibited the highest inhibition level of the Ames response induced by the indirect mutagen AFB1. Whereas, ethyl acetate and methanol extracts exhibited the highest level of protection towards the direct mutagen, sodium azide, induced response. In addition to antimutagenic activity, these extracts showed an important free radical scavenging activity towards the 1,1-diphenyl-2-picrylhydrazyl (DPPH) free radical. TOF, ethyl acetate and methanol extracts showed IC50 value of 15, 14 and 20 μg/ml, respectively.

Taken together, our finding showed that C. rotundus exhibits significant antioxidant and antimutagenic activities.

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http://www.sciencedirect.com/science/article/pii/S0254629911000482
South African Journal of Botany, Volume 77, Issue 3, August 2011, Pages 767–776

Phytochemical, antimicrobial, antioxidant and antigenotoxic potentials of Cyperus rotundus extracts

S. Kilani-Jaziria, et al.

Abstract

The aqueous, ethyl acetate, methanolic and Total Oligomer Flavonoids (TOF) enriched extracts, obtained from the aerial parts of Cyperus rotundus, were investigated for their contents in phenolic compounds. Antioxidative activity using the NBT/riboflavin assay system, antimicrobial activity against Gram positive and Gram negative bacterial reference strains as well as antigenotoxic activity tested with the SOS chromotest assay were also studied. Significant antibacterial activity against reference strains; Staphylococcus aureus, Enterococcus faecalis, Salmonella enteritidis and Salmonella typhimurium, was detected in the presence of ethyl acetate and TOF enriched extracts. In addition to their antimicrobial activity, the same extracts showed a significant ability to inhibit nitroblue tetrazolium reduction by the superoxide radical in a non enzymatic O2.- generating system, and were also able to reduce significantly the genotoxicity induced by nifuroxazide and Aflatoxin B1. The antioxidant, antimicrobial and antigenotoxic activities exhibited by C. rotundus depend on the chemical composition of the tested extracts.

Research Highlights

We determined phenolic content of C. rotundus aerial part extract. Significant antibacterial activity was detected with ethyl acetate and TOF enriched extracts. Same extracts showed a significant ability to inhibit superoxide radicals. These extracts were able to reduce significantly the genotoxicity induced by genotoxic AFB1 and NF. We established correlations between tested activities and chemical composition.

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http://www.sciencedirect.com/science/article/pii/003194229500260E
Phytochemistry, Volume 40, Issue 1, September 1995, Pages 125–128

Antimalarial sesquiterpenes from tubers of Cyperus rotundus: structure of 10,12-Peroxycalamenene, a sesquiterpene endoperoxide

C. Thebtaranonth, et al.

Abstract

Activity-guided investigation of Cyperus rotundus tubers led to the isolation of patchoulenone, caryophyllene a-oxide, 10,12-peroxycalamenene and 4,7-dimethyl-1-tetralone. The antimalarial activities of these compounds are in the range of EC50 10-4–10-6M, with the novel endoperoxide sesquiterpene, 10,12-peroxycalamenene, exhibiting the strongest effect at EC50 2.33 × 10-6M.

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http://onlinelibrary.wiley.com/doi/10.1002/cbdv.200890069/abstract;jsessionid=ADF8738380FBB3FCDF4715D9B1B9FD50.f04t04
DOI: 10.1002/cbdv.200890069
Chemistry & Biodiversity, Volume 5, Issue 5, pages 729–742, May 2008

Comparative Study of Cyperus rotundus Essential Oil by a Modified GC/MS Analysis Method. Evaluation of Its Antioxidant, Cytotoxic, and Apoptotic Effects

Soumaya Kilani, et al.

Abstract

Gas chromatography coupled with mass spectrometry (GC/MS), using both electron impact (EI) and chemical ionization (CI) detection modes on apolar and polar stationary phases, led to the determination of the volatile composition of the essential oil obtained from tubers of Cyperus rotundus (Cyperaceae). In this study, more than 33 compounds were identified and then compared with the results obtained in our previous work. Cyperene, a-cyperone, isolongifolen-5-one, rotundene, and cyperorotundene were the principal compounds comprising 62% of the oil. An in vitro cytotoxicity assay with MTT indicated that this oil was very effective against L1210 leukaemia cells line. This result correlates with significantly increased apoptotic DNA fragmentation. The oxidative effects of the essential oil were evaluated using the 1,1-diphenyl-2-picrylhydrazyl (DPPH), xanthine/xanthine oxidase assays, and the scavenging of superoxide radical assay generated by photo-reduction of riboflavin. The antimutagenic activity of essential oil has been examined by following the inhibition of H2O2 UV photolysis which induced strand-break formation in pBS plasmid DNA scission assay. Based on all these results, it is concluded that C. rotundus essential-oil composition established by GC/MS analysis, in EI- and CI-MS modes, presents a variety of a chemical composition we were not able to detect with only GC/MS analysis in our previous work. This essential oil exhibited antioxidant, cytotoxic, and apoptotic properties.

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http://www.hindawi.com/journals/jchem/2007/903496/abs/
E-Journal of Chemistry, Volume 4 (2007), Issue 3, Pages 440-449
http://dx.doi.org/10.1155/2007/903496

in vitro Antioxidant Activity and Total Polyphenolic Content of Cyperus rotundus Rhizomes

KR. Nagulendran, S. Velavan, R. Mahesh, and V. Hazeena Begum

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Abstract

In this study, Antioxidant activity of Cyperus rotundus rhizomes extract (CRRE) was evaluveted in a series of in vitro assay involving free radicals and reactive oxygen species and IC50 values were determined. CRRE exhibited its scavenging effect in concentration dependent manner on superoxide anion radicals, hydroxyl radicals, nitric oxide radical, hydrogen peroxide, and property of metal chelating and reducing power. The extract was also studied for lipid peroxidation assay by thiobarbituric acid–reactive substances (TBARS) using young and aged rat brain mitochondria. The extract was also effective in preventing mitochondrial lipid peroxidation induced by FeSO4/ ascorbate in concentration dependent manner. The results obtained in the present study indicate that C. rotundus rhizomes extract can be a potential source of natural antioxidant.

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http://online.liebertpub.com/doi/abs/10.1089/jmf.2006.090
Journal of Medicinal Food. December 2007, 10(4): 667-674. doi:10.1089/jmf.2006.090.

In Vitro Antioxidant and Free Radical Scavenging Activity of Cyperus rotundus

R. Yazdanparast and A. Ardestani.

ABSTRACT

Cyperus rotundus (Family Cyperaceae) is used both as a functional food and as a drug. In this study, the antioxidative potential of a hydroalcoholic extract of C. rotundus (CRE) was evaluated by various antioxidant assays, including antioxidant capacity by the phosphomolybdenum method, total antioxidant activity in linoleic acid emulsion systems, 1,1-diphenyl-2-picrylhydrazyl (DPPH), superoxide, hydroxyl radicals, and nitric oxide (NO) scavenging. We further evaluated the reducing potential of the extract as well as Fe2+/ascorbate-induced lipid peroxidation in rat liver homogenate. These various antioxidant activities were compared to

standard antioxidants such as butylated hydroxytoluene, tocopherol, L-ascorbic acid, and catechin. Total phenolic and flavonoid content of CRE was also determined by a colorimetric method. The extract exhibited high reduction capability and powerful free radical scavenging, especially against DPPH and superoxide anions as well as a moderate effect on NO. CRE also showed inhibited lipid peroxidation in rat liver homogenate induced by Fe^{2+}/ascorbate and prevented deoxyribose degradation in both non–site-specific and site-specific assays showing the hydroxyl radical scavenging and metal chelating activity of the hydroalcoholic extract. Moreover, the peroxidation inhibiting activity of CRE was demonstrated in the linoleic acid emulsion system. These results clearly established the antioxidative potency of C. rotundus, which may account for some of the medical claims attributed to this plant.

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http://www.ijpsonline.com/article.asp?issn=0250-474X;year=2006;volume=68;issue=2;spage=256;epage=258;aulast=Pal

Evaluation of the Antioxidant activity of the roots and Rhizomes of Cyperus rotundus L.

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Abstract

The in vitro antioxidant activity of the roots and rhizomes of Cyperus rotundus L. has been investigated by estimating degree of non-enzymatic haemoglobin glycosylation, measured colorimetrically at 520 nm. The ethanol extract of the roots and rhizomes of C. rotundus showed higher activity, than other extracts of it. The antioxidant activity of the extracts are close and identical in magnitude, and comparable to that of standard antioxidant compounds used...

The roots and rhizomes of C. rotundus L. were collected from Panua, in the district of Bankura, West Bengal in the month of June, and were authenticated at the Central National Herbarium, Botanical Survey of India, Howrah, West Bengal. A voucher specimen has been preserved in our laboratory for future reference (DPS 1). Shade-dried, powdered, sieved (40 mesh size) plant materials were exhaustively extracted successively with petroleum ether (40-60 C), chloroform, ethanol, and distilled water, using a soxhlet extractor. The extracts were concentrated to dryness in vacuum. The yield of petroleum ether, chloroform, ethanol, and water extracts, were 1.5%, 2.4%, 12.3% and 9.2%, respectively. The ethanol extract was subjected to silica gel preparative TLC, where two compounds were isolated using chloroform : ethanol (9:1) as solvent system.

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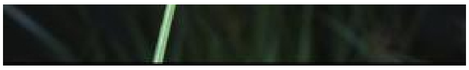
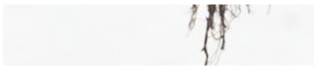
http://www.ipm.ucdavis.edu/PMG/WEEDS/purple_nutsedge.html

Purple nutsedge (Cyperus rotundus)



Purple nutsedge is a perennial weed in the sedge family and superficially resembles grass. Nutsedges are among the most noxious weeds of agriculture in temperate to tropical zones worldwide. They are difficult to control, often form dense colonies, and can greatly reduce crop yields. In California, nutsedges are particularly problematic in summer-irrigated annual and perennial crops. Purple nutsedge is not as widespread in California as yellow nutsedge, Cyperus esculentus, and grows in the Central Valley, South Coast, and low desert to an altitude of about 820 feet (250 m). It also resembles another sedge, green kyllinga, Kyllinga brevifolia. Purple nutsedge tubers are bitter and are used medicinally in India and China.

Seedling

Seedlings are rare. When found, seedling leaves are similar to that of the mature plants, but smaller. The stem base is slightly triangular and the midvein area is usually pale. The first two to three leaves emerge together, folded lengthwise.

Young plant

Purple nutsedge propagates by tubers formed on underground, horizontal creeping stems called rhizomes, mostly in the upper foot of soil. Sprouts from tubers are similar in appearance to the mature plant.

Mature plant

The purple nutsedge stem is erect, glossy, and hairless. Although its leaves superficially resemble grass leaves, they lack collars, ligules, and auricles. The leaves of purple nutsedge are thicker and stiffer than most grasses, are V-shaped in cross-section, and arranged in sets of three from the base rather than sets of two as in grass leaves. Purple nutsedge flowering stems are triangular in cross-section; grass stems are hollow and round. Purple nutsedge can be distinguished from yellow nutsedge because it has shorter stems and grows only up to 1-1/3 feet (0.4 m) tall, whereas yellow nutsedge stems can grow to 3 feet (0.9 m) tall. Purple nutsedge leaves are dark green, 1/8 to 4/17 of an inch (3–6 mm) wide, and have rounded tips; yellow nutsedge has light green leaves, a pointed tip, and a leaf width of 1/6 to 2/5 of an inch (4–9 mm). Purple and yellow nutsedge are also distinguished by their tubers. Tubers of purple nutsedge are produced in chains, with several on a single, horizontal, underground creeping stem (rhizome), while those of yellow nutsedge are produced singly. Another similar sedge, green kyllinga, Kyllinga brevifolia, has rhizomes but no underground tubers.

Flowers

Purple nutsedge spikelets are dark reddish to purplish brown with few flowers in each cluster. Yellow nustsedge spikelets are straw-colored to gold-brown with many flowers. Green kyllinga has green flowers on a compressed flower head.

Fruits

Purple nutsedge does not typically produce seeds in the United States. This is in contrast to yellow nutsedge, which produces tiny single-seeded fruit.

Reproduction

Purple nutsedge grows mainly from tubers formed on horizontal, underground, creeping stems called rhizomes, mostly in the upper foot of soil.

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http://plants.usda.gov/plantguide/pdf/pg_cyro.pdf

USDA Plant Guide : Purple Nutsedge

[PDF]

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http://en.wikipedia.org/wiki/Cyperus_rotundus

Cyperus rotundus

Nutgrass Cyperus rotundus
Scientific classification
Kingdom: Plantae
(unranked): Angiosperms
(unranked): Monocots
(unranked): Commelinids
Order: Poales
Family: Cyperaceae
Genus: Cyperus

Species: C. rotundus
Binomial name
Cyperus rotundus L.



Cyperus rotundus (coco-grass,[1] Java grass,[1] nut grass,[1] purple nut sedge,[1] red nut sedge,[1] Khmer kravanh chruk[2]) is a species of sedge (Cyperaceae) native to Africa, southern and central Europe (north to France and Austria), and southern Asia. The word cyperus derives from the Greek ??pe???, kyperos,[3] and rotundus is from Latin, meaning "round".[4] The earliest attested form of the word cyperus is the Mycenaean Greek ??????, ku-pa-ro, written in Linear B syllabic script.[5]

Cyperus rotundus is a perennial plant, that may reach a height of up to 140 cm (55 inches). The names "nut grass" and "nut sedge" – shared with the related species Cyperus esculentus – are derived from its tubers, that somewhat resemble nuts, although botanically they have nothing to do with nuts.

As in other Cyperaceae, the leaves sprout in ranks of three from the base of the plant, around 5–20 cm long. The flower stems have a triangular cross-section. The flower is bisexual and has three stamina and a three-stigma carpel, with the flower head have 3-8 unequal rays. The fruit is a three-angled achene.

The root system of a young plant initially forms white, fleshy rhizomes, up to 25 mm in dimension, in chains. Some rhizomes grow upward in the soil, then form a bulb-like structure from which new shoots and roots grow, and from the new roots, new rhizomes grow. Other rhizomes grow horizontally or downward, and form dark reddish-brown tubers or chains of tubers.

It prefers dry conditions, but will tolerate moist soils, it often grows in wastelands and in crop fields.[2]

Invasive problems and eradication

Cyperus rotundus is one of the most invasive weeds known, having spread out to a worldwide distribution in tropical and temperate regions. It has been called "the world's worst weed"[6] as it is known as a weed in over 90 countries, and infests over 50 crops worldwide.[citation needed] In the United States it occurs from Florida north to New York and Minnesota and west to California and most of the states in between. In the uplands of Cambodia, it is described as an important agricultural weed.[2]

Its existence in a field significantly reduces crop yield, both because it is a tough competitor for ground resources, and because it is allelopathic, the roots releasing substances harmful to other plants. Similarly, it also has a bad effect on ornamental gardening. The difficulty to control it is a result of its intensive system of underground tubers, and its resistance to most herbicides. It is also one of the few weeds that cannot be stopped with plastic mulch.[citation needed]

Weed pulling in gardens usually results in breakage of roots, leaving tubers in the ground from which new plants emerge quickly. Ploughing distributes the tubers in the field, worsening the infestation; even if the plough cuts up the tubers to pieces, new plants can still grow from them. In addition, the tubers can survive harsh conditions, further contributing to the difficulty to eradicate the plant. Hoeing in traditional agriculture of South East Asia does not remove the plant but leads to rapid regrowth.[2]

Most herbicides may kill the plant's leaves, but most have no effect on the root system and the tubers. Glyphosate will kill some of the tubers (along with most other plants) and repeated application can be successful. Halosulfuron-methyl (chemical name: Methyl 5-[((4,6-dimethoxy-2pyrimidinyl)amino)carbonylaminosulfonyl]-3-chloro-1-methyl-1H-pyrazole-4-carboxylate),[7] brand name "Manage" (now renamed "SedgeHammer" in the USA) or "Sempra" in Australia, will control nut grass after repeated applications without damaging lawns.[citation needed]. In Cambodia the plant does not tolerate shading, while 2,4-D (2,4-Dichlorophenoxyacetic acid slows growth in pastures and mulch crops.

Uses and positive aspects

Despite its bad reputation, Cyperus rotundus has several beneficial uses.

Folk medicine

The plant is used in popular medicine:

In traditional Chinese medicine it is considered the primary qi regulating herb.

The plant is mentioned in the ancient Indian ayurvedic medicine Charaka Samhita (ca. 100 CE). Modern ayurvedic medicine uses the plant, known as musta or musta moola churna,[8][9] for treating fevers, digestive system disorders, dysmenorrhea and other maladies.

Arabs of the Levant traditionally use roasted tubers, while they are still hot, or hot ashes from burned tubers, to treat wounds, bruises, carbuncles, etc. Western and Islamic herbalists including Dioscorides, Galen, Serapion, Paulus Aegineta, Avicenna, Rhazes, and Charles Alston have described medical uses as stomachic, emmenagogue, deobstruent and in emollient plasters.[10][11]

The antibacterial properties of the ingested tubers also apparently helped prevent tooth decay in people who lived in Sudan 2000 years ago. Less than one percent of that local population's teeth had cavities, abscesses, or other signs of tooth decay, even though those people were probably farmers (early farmers teeth typically had more tooth decay than hunter gatherers because the high grain content in their diet created a hospitable environment for bacteria that flourish in the human mouth , excreting acids that eat away at the teeth).[12][13]-

Modern uses and studies

Modern alternative medicine recommends using the plant to treat nausea, fever and inflammation; for pain reduction; for muscle relaxation and many other disorders.

Several pharmacologically active substances have been identified in Cyperus rotundus: a-cyperone, ß-selinene, cyperene, patchoulenone, sugeonol, kobusone, and isokobusone, that may scientifically explain the folk- and alternative-medicine uses. A sesquiterpene, rotundone, so called because it was originally extracted from the tuber of this plant, is responsible for the spicy aroma of black pepper and the peppery taste of certain Australian Shiraz wines.[14]

Food

Despite the bitter taste of the tubers, they are edible and have nutritional value. Some part of the plant was eaten by humans at some point in ancient history. The plant is known to have a high amount of carbohydrates.[15] The plant is known to have been eaten in Africa in famine-stricken areas.

In addition, the tubers are an important nutritional source of minerals and trace elements for migrating birds such as cranes. [citation needed]

Sleeping mats

The well dried coco grass are used as mats for sleeping.
