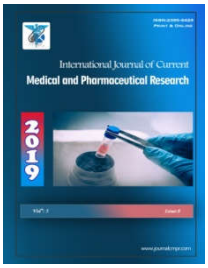
INTERNATIONAL JOURNAL OF CURRENT MEDICAL AND PHARMACEUTICAL RESEARCH
ISSN: 2395-6429, Impact Factor: 4.656
Available Online at www.journalcmpr.com
Volume 5; Issue 08(A); August 2019; Page No. 4425-4428
DOI: http://dx.doi.org/10.24327/23956429.ijcmpr201908713



Research Article

LEMON PEEL -A PHARMACOTHERAPY FOR DENTAL CARIES AND PERIODONTITIS

Patil T.R[1]., Patil[2]., Patil ST[3] and Patil A[4]

[1]Consultant Physician and Pharmacologist, Gurukripa, Station Road, Miraj, Maharashtra, India
[2]Department of Public Health Dentistry School of Dental Sciences Karad, Maharashtra, India
[3]Gynecologist, Gurukripa, Station Road, Miraj, Maharashtra, India
[4]Oral pathologist, Ministry of Health, Dubai

ARTICLE INFO

Article History:
Received 12th May, 2019
Received in revised form 23rd June, 2019
Accepted 7th July, 2019
Published online 28th August, 2019

Key words:
Antimicrobial, lemon peel, dental caries, periodontitis

ABSTRACT

Citrus fruit like citrus limon commonly called lemon has been found to have numerous beneficial properties. Usually, the fruit pulp is used for juice, and its various products and peel is discarded as waste material. Now it is a high time to understand the myriad benefits of lemon peel. It has been proved to have anticancer, antibacterial, antiviral, antifungal, and antidiabetic properties. Lemon peel contains essential oils and other constituents responsible for these actions. Constituents of essential oil are monoterpenes, sesquiterpenes, aldehyde, esters, alcohol, and ketone. It also contains limonine, carvone and alphaterinone. Studies revealed antimicrobial properties of lemon peel which help in preventing the growth of common oral organisms like Streptococcus mutans, prevotella intermedia and porphyromonasgingivalis which are the causative organisms for dental caries and periodontitis. Four chemical substances were isolated and identified responsible for the antimicrobial activity of lemon peel. These were 8-geranyloxypsolaren,5-geranyloxypsolaren,5-geranyloxy-7-methoxycoumarin and phloroglusinol-1-beta-D-glucopyranoside [phlorin]. Hence it can be considered that the inclusion of lemon peel in a suitable form for dental treatment should maintain good oral hygiene and prevent the occurrence of dental caries and periodontitis. Further studies would encourage the regular usage of lemon peel as a therapeutic agent.

INTRODUCTION

Citrus fruits like lemon and orange are cultivated for extracting their juice, leaving behind the citrus peel which is discarded as waste product unfortunately without knowing their medicinal values.

Despite the advent of many new antimicrobial drugs, the drug resistance still poses a major problem.[1]The plant extracts and phytochemicals have been tried and proved to possess significant antimicrobial properties.[2]Phenolic compounds which are the major constituents of the essential oils and tannins, produced during the secondary metabolism of plants, possess antimicrobial properties.[3]Essential oils have better diffusibility which enhances their antimicrobial potential.[4] Flavonoids present in the citrus fruits possesses antidiabetic, anticancer, antibacterial, antiviral and antifungal activities.[5,6] Flavonoids also bear antioxidant and free radical scavenging potential which affects bacterial cellular enzymes and inhibit cell proliferation.[7,8]

One gets surprised to know that there is hardly any infectious disease affecting the lemon fruit. This is due to the presence of antimicrobial substances in the lemon peel, which were found to be active against various Gram-positive and negative bacteria.

Citrus limon, commonly called as lemon, belongs to Rutaceae family. The peel of this fruit is rich in flavonoids, glycosides, coumarins and volatile oils.[9]Polymethoxylated flavonoids present in the lemon peel are responsible for many bioactivities.[10]Certain constituents of peel extract like essential oils, corydaline alkaloids, protopine, lactones, polyacetylenehypericin and pseudohypericin possess antimicrobial properties which were confirmed by various studies.[11-13] Alcohols, esters, aldehydes and some active terpenes also contribute to the antimicrobial actions of essential oils.[14,15] It has been proved that coumarin, a type of flavoprotein present in lemon peel, acts as antimicrobial substance.[16]

Solvents like ethanol, methanol and acetone were used for the extraction of ingredients from lemon peel which were eventually studied for their antimicrobial potential.[1, 17]
Actions of Citrus limon peel-

Lemon peel was found to possess anticancer, antimicrobial and antioxidant properties.[18] Antioxidant and antimicrobial

*Corresponding author: **Patil T.R**
Consultant Physician and Pharmacologist, Gurukripa, Station Road, Miraj, Maharashtra, India

properties are due to the presence of flavonoids and essential oils. [19] Flavonoids like naringin and hesperidine stimulate the function of white blood cells and enhance immune mechanism.[20,21] Essential oil contains monoterpenes, sesquiterpenes, aldehyde, esters, alcohol and ketones. Monoterpenes bear higher antimicrobial activity than the hydrocarbons. The essential oil also contains limonene, carvone and alpha terinone, which were found to have antimicrobial and antifungal activity.[20, 22] Limonene and gama terpene constituents of essential oil were active against E.coli. Ethanolic extract of Citrus limon peel in the concentration ranging from 25% to 100% showed strong antimicrobial activity against these organisms.[23] They can disrupt the bacterial membrane and inhibit the respiration and the ion transport, resulting in to the increased bacterial cell membrane permeability which promote the diffusion of the essential oils through the cell wall and cytoplasmic membrane.[24] This results in the coagulation of cytoplasm and damage to the protein and lipid layers.[25] Flavonoids also have anti-inflammatory and antioxidant activity in addition to antimicrobial property. They also have the ability to inhibit specific enzymes, to stimulate some hormones and neurotransmitters and scavenge free radicals.[26]

The citrus fruit peel is rich in flavonoids, glycosides, coumarins, beta and gamasitosterol, glycosides and volatile oils.[9]Presence of many polymethoxylated flavones have several important bioactivities which is the unique feature of lemon peel.[27]

The essential oils, protopines, and corydaline alkaloids, polyacetylene, lactons, acyclic sesquiterpenes, hypericin and pseudohypericin present in the lemon peel are responsible for antimicrobial activity. Other active terpenes, aldehydes, esters, and alcohols also contribute to this action of essential oils.[15]

Lemon peel extract can be obtained by using solvents like ethanol, methanol and acetone. The lemon peel extract obtained from solvents like ethanol showed higher antimicrobial activity than that of methanol and acetone.[12]One study revealed that the antimicrobial activity of methanol extract of lemon peel was superior to that of ethanol and acetone extract against E.coli, S. aureus. Candida albicans and Trichophyton rubrum.[28]

Peels and seeds constitute about 25-30% of non-edible portions of fruits and vegetables which were found to possess antimicrobial and antioxidant compounds.[29] Citrus peels which are the byproduct waste exhibit antibacterial, antifungal, antiviral, antidiabetic and anticancer activity.[5,6] Lemon peel consists of two layers, out of which the outermost is called Zest. This contains essential oils [6%]. Essential oil is composed of 90% limonene, 5% citral and a small amount of cintronelene, alpha terpincol, linayl and gernanyl acetate and B complex vitamins. It is being used to dissolve gall stones and also possesses anticancer property.[30] Utilizing the peels not only reduces the burden of solid waste but also adds medicinal value to this material. Phenolic compounds and flavonoids present in the lemon peel are inhigher quantity than in the pulp.[31]

Antioxidant properties of lemon peel- Phenolic compounds possess antioxidant properties like scavenging of free radicals and reactive oxygen species, metal chelation and peroxide decomposer. Compounds of lemon peel like tetrazine and coumarin are capable of scavenging free radicals either by electron or by hydrogen donation, breaking the chain reaction or removing the reactive oxygen species [ROS] and reactive nitrogen species [RNS] initiator by quenching chain initiator catalyst.[32]The antioxidant activity of lemon peel was confirmed by using DPPH assay and phosphomolybdenum reduction assay. The reducing capacity which is an important indicator of antioxidant potential of lemon peel was determined by using FRAP assay and posphomolybdenum assay.[33]

Polymethoxylatedflavons of lemon peel have anti-inflammatory, anticancer, antiviral activity and also reduce the capillary fragility.[34] Limonoids present in the citrus fruit peel contribute to the antibacterial and antifungal activity.[35]

Lemon peel in the treatment of dental caries and periodontitis
Polyphenols present in the green tea and red grape were found to inhibit the growth of oral bacteria responsible for dental caries and periodontitis.[36,37] Oral bacteria responsible for dental caries and periodontitis are Streptococcus mutans, Prevotella intermedia, and Porphyromonasgingivalis. Lemon peel exhibited antibacterial activity against these causative organisms. Poor oral hygiene, dental plaque and bacteria present in the plaque ferment dietary carbohydrates resulting in the production of acid and dissolution of dental hard tissues.[38,39]Streptococcus mutans which is the commonest causative organism for dental caries formation gets colonized in the oral cavity at the early age of 6-9months and remains there till teeth are present.[40]Yoshiakia Miyake and Masanori Hiramitsu isolated and identified by instrumental analysis, following four antibacterial substances which were found to be active against these organisms. These isolated and identified substances from the lemon peel are 8-geranyloxypsolaren,5-geranyloxypsolaren,5-geranyloxy-7-methoxycoumarin and phloroglucinol-1-beta -D-glucopyranoside [Phlorin]. Amongst these, the first three compounds were abundantly present in essential oil and were extracted by ethanol and N-hexene, which exhibited high antibacterial activity against these organisms. The fourth compound phlorin extracted with water had less antibacterial potency. Phlorin exhibited higher antibacterial activity against Prevotella intermedia than against Streptococcus mutans and Porphyromonasgingivalis. Phlorin is hydrophilic and the remaining three substances are hydrophobic in nature.[41] Inhibition of the growth of the above mentioned oral bacteria is the important modality to prevent and treat these oral diseases.[42]

Kiran Mathai *et al* studied the effect of lemon peel extract on Streptococcus mutans and found the inhibition of these organisms responsible for dental caries and periodontitis.[43]
Effect of lemon peel on other organisms-

Sneh Gupta *et al* studied the antimicrobial potential of lemon peel against various organisms like Staph. aureus, Staph. Epidermidis, Bacillus cereus, Bacillus subbtilis, Bacillus mycoides, Listeria monocytogenes, Micrococcus aerugenosa, Escherichia coli, Enterobacterogenes and Pseudomonas aerugenosa. It was effective against all these species of bacteria but more with Gram positive than negative. Antifungal activity of lemon peel was found against Alternariaspecies and Rhizopus species which are the common food spoiling organisms. When compared with lemon peel the lemon oil showed better antimicrobial, antifungal activity.[44] Flavonoids in the citrus fruits are important secondary metabolites which are present in higher concentration in the lemon peel than in the other parts of fruit.[45]

A study done by Sheila John *et al* found that the ethanolic and methanolic extract of lemon peel exhibited antibacterial activity against S.aureus, E.coli, Shigellaflexneri and Klebsiella pneumoniae.[33] Alcoholic extract of lemon peel was also found to have antibacterial activity against S. typhimurium and P.aeruginosa.[12]

W.M. Otang and A.J. Afolayan found the highest antibacterial activity of acetone extract of C. Limon against E. fecalis and B. subtilis in their studies. Lemon peel extract also exhibited antimicrobial activity against Gram-positive bacteria like Enterococcus fecalis, Bacillus cereus, Bacillus subtilis, Streptococcus pyogenes, Klebsiella pneumonia and Staph. aureus and Gram-negative organisms like E. Coli, S. typhymurium, Pseudomonas aeruginosa, Shigellasonnei and Shigellaflexneri. It also exhibited antifungal activity against Candida glabrata.[46]

Lemon peel was also found to be active against the variety of microorganisms responsible for skin diseases. The most prevalent bacteria are Staphylococcus aureus, Streptococcus pyogenes, Pseudomonas aeruginsoa, clostridium perfringes, and the bacteroids group.[47]Cutaneous infections like cellulitis, impetigo, folliculitits, erysipelas, furuncles, carbuncle and abscess are most commonly caused by S.aureus and S.pyogenes. Common fungal infection of the skin is caused by Trichophyton rubrum and candida albicans.[48]

Safety profile of citrus limon peel

Citrus limon peel was found extremely safe during acute toxicity studies done in animal experiments. In rat model, rats were fed with Lemon peel extract in a dose of 2000mg/Kg orally and they were followed up to 14days for any signs and symptoms of poisoning or death. They were absent in these studies. No features of acute toxicity were found. Hence it is inferred that lemon peel is quite safe preparation for consumption.[49,50]

Summary

Dental diseases like dental caries and periodontitis result in tooth loss if not treated adequately and effectively in time. Microorganisms causing these disorders are observed to be resistant to various antibiotics available at present. Lemon peel proves to be an effective, economical and safe alternative to treat these diseases. Antimicrobial action of lemon peel prevents the growth of oral organisms like Streptococcus mutans, Prevotella intermedia and Porphyromonasgingivalis responsible for dental caries and periodontitis. Controlled studies done with suitable preparation of lemon peel will confirm its promising role which will encourage its regular use in dental practice.

References

1. Gislene GF, LocatelliNJ, Paulo CF, Giuliana LS. Antibacterial activity of plant extracts and phytochemicals on antibiotic resistant bacteria. *Braz. J. Microbiol*., 2000; 31: 247-256.
2. Seenivasan P, Manickkam J, Savarimuthu I. In vitro antibacterial activity of some plant essential oils. BMC Complem. Altern. M. 2006; 6: 39.
3. Tyagi AK, Malik A. Liquid and vapour-phase antifungal activities of selected essential oils against candida albicans. BMC Complem. Altern. M. 2010; 10: 65.
4. Al-Shuneigat J, Cox SD, MarkhamJL. Effects of a topical essential oil containing formulation on biofilm-forming coagulase-negative staphylococci. Lett. Appl. Microbiol., 2005; 41: 52-55.
5. Burt SA. Essential oils: Their antibacterial properties and potential applications in foods: A review. *Inter. J. Food Microbiol*. 2004; 94: 223-253.
6. Ortuno AA, Baidez P, GomezMC, ArcasI, Porras AG, Del RioJA. Citrus paradisi and Citrus sinensis flavonoids: Their influence in the defense mechanism against Penicilliumdigitatum. Food Chem., 2006; 98(2): 351-358.
7. Duthie G, Crozier A. Plant-derived phenolic antioxidants. Curr. Opin. Lipidol., 2000; 11: 43-47.
8. Sohn HY, SonKH, Know CS, KangSS. Antimicrobial and cytotoxic activity of 18 prenylated flavonoids isolated from medicinal plants: Morusalba L., Morusmongolica Schneider, Broussnetiapapyrifera (L.) Vent, Sophoraflavescens Ait and Echinosophorakoreensis Nakai. Phytomedicine, 2004; 11: 666-672.
9. Shahnah SM, Ali S, Bagri P. New sequitur penetrative derivative from fruit peel of citrus lemon (Linn) Burn. F. Sci. Pharmaceutical, 2007; 75: 165-170.
10. Ahmed A, Hakan O, Munevver S. Antimicrobial and antioxidant of the essential oil and methanol extract of Napata cutaria. *Journal of Microbiology*, 2008; 58: 69-79.
11. Hammer KA, Carson CF, Riley TV. Antimicrobial activity of essential oils and other plant extracts. *Journal App Microbiol*, 1999; 86: 985-900.
12. Dhanavade MJ, Chidamber JB, Ghosh JS, Sonawane KD. Study antimicrobial activity of lemon Citrus lemon L. peel extract, *British Journal of pharmacology and toxicology* 2011; 2[3]: 119-122.
13. Kumar A, Narayani M, Subanthini A, Jayakumar M, Antimicrobial activity & phytochemical analysis of citrus fruit peels-utilization of fruit waste, *Int J EnggSci Tech*, 2011; 3: 5414-5421.
14. Cushnie TA, Lamb JA, Antimicrobial Activity of flavonoids, Int Journal Antimicrobial 2000; 26: 343-356.
15. Keles OS, Bakirel AT, Alpinar K. Screening of some Turkish plants for antibacterial activity. Turk. J. Vet. Anim. Sci, 2001; 25: 559-565.
16. Dormans HJ, Deans SG. Antimicrobial Agent from plant: Antibacterial activity of plant volatile oils. Journal Appl Microbial, 2000; 88: 308-316.
17. Al-MajedyYK, Al-Duhaidahawi D, Al-Azawi K, Al-Amiery A, Kadhum AA, Mohamad AB. Coumarins as Potential Antioxidant Agents Complemented with Suggested Mechanisms and Approved by Molecular Modeling Studies. Rev.pharm 2016; 8: 62-70.
18. DevC, NidhiSRRS. Basketful Benefit of Citrus limon. *International Research Journal of Pharmacy*, 2016; 7: 1-3.
19. AdhamAN. Extract of Citrus Fruits Growing in Kurdistan/Iraq. *American Journal of Microbiology Research*, 2015; 3; 155-159.
20. Berk Z. Morphology and Chemical Composition in Citrus Fruit Processing. New York: Elsevier, 2016: 13-29.
21. ChebouatE, DadamoussaB, GharabliS, GherrafN, AllaouiM, CheritiA *et al*. Assessment of Antimicrobial Activity of Flavonoids Extract from Ephedra alata. Der Pharmacia Lettre, 2014; 6: 27-30.
22. VimalM, VijayaPP, MumtajP, Farhath MSS. Antibacterial Activity of Selected Compounds of Essential Oils from Indigenous Plants. *Journal of Chemical and Pharmaceutical Research*, 2013; 5: 248-53.
23. HendersonaAH, FachrialbE, NyomanI, Lister E. Antimicrobial Activity of Lemon (Citrus limon) Peel Extract Against Escherichia coli. *American Scientific Research Journal for Engineering, Technology, and Sciences* (ASRJETS) 2018; 39: 268-273.

24. MoosavyMH, HassanzadehP, MohammadzadehE, MahmoudiR, KhaitibiSA, MardaniK. Antioxidant and Antimicrobial Activities of Essential Oil of Lemon (Citrus limon) Peel in Vitro and in a Food Model. Journal of Food Quality and Hazards Control, 2017; 4: 42-48.
25. AktharMS, DegagaB, AzamT. Antimicrobial Activity of Essential Oils Extracted from Medicinal Plants Against the Pathogenic Microorganisms: A Review. Biological Sciences and Pharmaceutical Research, 2014; 2(1): 1-5.
26. EzeabaraCA, OkekeCU, AziagbaBO. Flavonoid Content of Citrus Species Grown in Awka, Anambra State, Shouthern Nigeria. *International Journal of Agriculture and Biosciences,* 2013; 2(3): 103-7. .
27. Ahmad MM, Salim-ur-Rehman Z, Iqbal-AnjumFM,SultanJI. Genetic variability to essential oil composition in four citrus fruit species. Pak. J. Bot., 2006; 38(2): 319-324.
28. DhanavadeMJ, JalkuteCB, Ghosh JS, SonawaneKD.Study Antimicrobial Activity of Lemon (Citrus lemon L.) Peel Extract. *British Journal of Pharmacology and Toxicology* 2011; 2(3): 119-122.
29. Amit P, Arti K, Sudeep KT. Evaluation of antimicrobial activity and phytochemical analysis of Citrus limon. *J Pharm Biomed Sci* 2011;13:101-7.
30. Ayala-Zavala JF, Wang SY, Wang CY, Gonzalez-Aguilar GA. Effect of temperature on antioxidant capacity and aroma compounds in strawberry fruit. Lebensm. Wiss.u. -Technol., 2004; 37: 687-695.
31. Miyake Y, Yamamoto K, OsawaT. Isolation of eriocitrin (eriodictyol 7-rutinoside) from lemon fruit (Citrus limon L.) and its antioxidative activity. Food SciTechnolInt Tokyo., 1997; 3: 84-89.
32. GoulasV, Manganaris GA. Exploring the phytochemical content and the antioxidant potential of citrus fruits grown in Cyprus. Food Chem., 2012; 131: 39-47.
33. Guimaraes R, Barros L, Barreira JC, Sousa MJ, Carvalho AM, Ferreira IC. Targeting excessive free radicals with peels and juices of citrus fruits: grapefruit, lemon, lime and orange. Food ChemToxicol., 2010; 48(1): 99-106.
34. JohnS, Monica SJ, PriyadarshiniS, Sivaraj C, ArumugamP. Antioxidant and antimicrobial efficacy of lemon[citrus limonum L]peel. *Int. J. Pharm. Sci. Rev. Res*., 2017; 46(1): 115-118.
35. Wang L, Wang J, Fang L, Zheng Z, Dexian Z, Wang S, *et al*. Anticancer activities of citrus peel polymethoxy flavones related to angiogenesis and others. Biomed. Res. Int. 2014; 2014: 453972. doi: 10.1155/2014/ 453972. Epub 2014 Aug 28.
36. Corbo MR, Speranza B, Filippone A, Granatiero S, Conte A, Sinigaglia M *et al*. Study on the synergic effect of natural compounds on the microbial quality decay of packed fish hamburger. *Inter J Food Microb*., 2008; 127: 261-267.
37. Kakuda T, Takihara T, Sakane I, Mortelmans K. Antimicrobial activity of tea extracts against periodontopathic bacteria. Nippon Nôgeikagaku Kaishi 1994; 68:241-243.
38. Smullen J, Koutsou GA, Foster HA, Zumbé A, Storey DM. The antibacterial activity of plant extracts containing polyphenols against Streptococcus mutans. Caries Res 2007; 41:342-349.
39. Karikalan S, Mohankumar A. Studies on ampicillin resistant plasmid of Streptococcus mutans isolated from dental caries patients. Biotechnol Res Commun 2016; 9(1):151-156.
40. Yadav K, Prakash S. Dental caries: a review. *Asian J Biomed Pharm Sci* 2016; 6(53):1-7.
41. Nanda J, Sachdev V, Sandhu M, Deep-Singh-Nanda K. Correlation between dental caries experience and mutans streptococci counts using saliva and plaque as microbial risk indicators in 3-8 year old children. A cross sectional study. *J ClinExp Dent* 2015; 7 (1):e114-e118.
42. Miyake Y, Hiramitsu M. Isolation and extraction of antimicrobial substances against oral bacteria from lemon peel *J Food SciTechnol* 2011; 48(5):635-639.
43. Takahashi N, Schachtele CF. Effect of pH on the growth and proteolytic activity of Porphyromonasgingivalis and Bacteroides intermedius. *J Dent Res* 1990; 69:1266-1269.
44. Mathai K, Anand S, Aravind A, Dinatius P, Krishnan A, Mathai M. Antimicrobial Effect of Ginger, Garlic, Honey, and Lemon Extracts on Streptococcus mutans *The Journal of Contemporary Dental Practice*, 2017;18(11):1004-1008.
45. Gupta S, Gupta C, Prakash D, Garg AP. Comparative Study of Antimicrobial Effects of Lemon Oil and Peel Extract against Food-Spoilage Microbes. *J Nutrition Health Food Sci*.2017; 5(6):1-5.
46. Sawalha SMS, Arráez-Román D, Segura-Carretero A and FernándezGutiérrez A. Quantification of main phenolic compounds in sweet and bitter orange peel using CE-MS/MS. Food Chemistry. 2009; 116(2):567-574.
47. OtangWM, AfolayanAJ. Antimicrobial and antioxidant efficacy of Citrus limon L. peel extracts used for skin diseases by Xhosa tribe of Amathole District, Eastern Cape, South Africa. South *African Journal of Botany* 2016; 102: 46-49.
48. Kohen R. Skin antioxidants: their role in aging and in oxidative stress-new approaches for their evaluation. Biomedicine and Pharmacotherapy 1999; 53: 181-192.
49. Nesy EA, Mathew L. Studies on antimicrobial and antioxidant efficacy of Thevetianeriifolia, Juss leaf extracts against human skin pathogens. *International Journal of Pharmaceutical Sciences and Drug Research* 2014;6: 164-168.
50. Juan LV , CaoL, LIM, Zhang R, Bai F, Wei P. Effect of hydroalcohol extract of lemon (Citrus limon) peel on a rat model of type 2 diabetes Tropical *Journal of Pharmaceutical Research* July 2018; 17 (7): 1367-1372.
51. AkhilaS, BinduAR, Bindu K, Aleykutty N A. Phytochemical and pharmacological evaluation of Citrus Limon peel. *World journal of pharmacy and pharmaceutical sciences*. 2015; 4:1128-1135.

How to cite this article:

Patil T.R., Patil S., Patil ST and Patil A (2019) 'Lemon Peel -A Pharmacotherapy For Dental Caries And Periodontitis', *International Journal of Current Medical and Pharmaceutical Research,* 05(08), pp 4425-4428.

****