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List of references supporting the assessment of *Zea mays*, L., stigma

Draft

The European Medicines Agency acknowledges that copies of the underlying works used to produce this monograph were provided for research only with exclusion of any commercial purpose.

Abudayeh ZH, Karpiuk U, Kyslychenko V, Abualassal Q, Hassounah LK, Qadus S et al. A. Optimizing Extractability, Phytochemistry, Acute Toxicity, and Hemostatic Action of Corn Silk Liquid Extract. *J Chem* 2022; Article ID 3059725; <https://doi.org/10.1155/2022/3059725>

Adedapo A, Babarinsa O, Oyagbemi A, Adedapo A, Omobowaleet T. Cardiotoxicity study of the aqueous extract of corn silk in rats. *Mac Vet Rev* 2016; 39 (1):43-49

Almadiy AA, Ali Alasbahy AA, Gumaih HS, Nasr ES, Al-Maktari MA. The protective and therapeutic effect of corn silk extract on urolithiatic and hypertensive rats induced by ethylene glycol. *EJUA-BA (E J Univ of Aden Bas Appl Sci)* 2021; 2(4):151-160

Ammor K, Ez-zahra Amarti F, Lagzizir R, Mahjoubi F, Bousta D, Chaqroune A. Study of Antioxidant, Anti-inflammatory, Antinociceptive Activities and Toxicity of Stigmata of *Zea mays* Extracts. *Phytothérapie*, D 2019, DOI 10.3166/phyto-2019-0209

Azevedo AS, Seibert JB, Amparo TR, Antunes A dos Santos, Sousa LRD, et al. Chemical constituents, antioxidant potential, antibacterial study and photoprotective activity of Brazilian corn silk extract. *Food Sci. Techl, Camp*, 2022, 42, e98421, DOI: <https://doi.org/10.1590/fst.98421>

Barnes J, Anderson LA, Phillipson JD. Herbal Medicines, 3rd Edition. Pharmaceutical Press London, Chicago, 2007, p.191-192

British Herbal Compendium. Ed by Bradley PR. British Herbal Medicines Association 1992. p.69

British Herbal Pharmacopoeia. British Herbal Medicines Association 1983. p.238-239

British Herbal Pharmacopoeia. British Herbal Medicines Association 1996. p.64

Cao X, Wei Y, Ito Yoichiro. Preparative isolation of isorhamnetin from *Stigma maydis* using high-speed counter current chromatography. *J Liq Chrom Rel Technol*. 2009; 32(2):273–280
doi:10.1080/10826070802603369

Cha JH, Kim SR, Kang HJ, Myung HK, Ha AW, Kim WK. Corn silk extract improves cholesterol



- metabolism in C57BL/6J mouse fed high-fat diets. *Nutr Res Pract* 2016; 10(5):501-506
- Chang CC, Yuan W, Roan H-Y, Chang J-L, Huang H-C, Lee Y-C, Tsay HJ, Liu H-K. The ethyl acetate fraction of corn silk exhibits dual antioxidant and anti-glycation activities and protects insulin-secreting cells from glucotoxicity. *BMC Compl Alt Med* 2016; 16:432, DOI 10.1186/s12906-016-1382-8
- Culbert TP, Banez GA. Wetting the bed: Integrative approaches to nocturnal enuresis. *Paediatrics, Explore*, 2008; 4(3):215-220
- Daley MC, Mende U, Choi B-R, McMullen PD, Coulombe KKL. Beyond pharmaceuticals: Fit-for –Purpose new approach methodologies for environmental cardiotoxicity testing. *Altex*; 2023, 40(1):103-116
- Deng W, Yang X, Zhu Y, Yu J, Xu X. Structural characterization and hypolipidemic activities of purified stigma maydis polysaccharides. *Food Sci Nutr* 2019; 7:2674–2683
- Ding L, Ren S, Song Y, Zang C, Liu Y, Guo H et al. Modulation of gut microbiota and fecal metabolites by corn silk among high-fat diet-induced hypercholesterolemia mice. *Front. Nutr.* 2022; 9:935612. <https://doi.org/10.3389/fnut.2022.935612>
- Dymowski W., Jackiewicz K. How much of herbs do we measure with a spoon or teaspoon to prepare the infusion? The content of plant substances in selected spoons and teaspoons used in the last decades. *Almanach* 2020; 15(6):47-57 (in Polish)
- EFSA Scientific Opinion on the risks for public health related to the presence of zearalenone in food. EFSA Panel on Contaminants in the Food Chain. *EFSA Journal* 2011; 9(6):2197
- EFSA Scientific Opinion on risks for animal and public health related to the presence of nivalenol in food and feed. EFSA Panel on Contaminants in the Food Chain (CONTAM). *EFSA Journal* 2013; 11(6):3262
- El-Ghorab A, El-Massry KF, Shibamoto T. Chemical Composition of the Volatile Extract and Antioxidant Activities of the Volatile and Nonvolatile Extracts of Egyptian Corn Silk (*Zea mays* L.). *J Agric Food Chem* 2007; 55:9124–9127
- Farmakopea Polska III, 1954. Warszawa, Państwowy Zakład Wydawnictw Lekarskich, p.179 (Decocta), p.333 (Infusa) (in Polish)
- Farmacopeea Romana Ed A X-A. București 1998, Editura Medicală, 612 (in Romanian)
- Farsi DA, Harris CS, Reid L, Bennett SAL, Haddad PS, Martineau LC, Arnason JT. Inhibition of Non-enzymatic Glycation by Silk Extracts from a Mexican Land Race and Modern Inbred Lines of Maize (*Zea mays*). *Phytother. Res.* 2008; 22, 108-112 DOI: 10.1002/ptr.2275
- Frerichs G., Arends G, Zöring H (Ed.) Hagers Handbuch der Pharmazeutischen Praxis. Zw. Band, Springer-Verlag Berlin Göttingen Heidelberg 1949, p.145 (Stigmata Maydis)
- George GO, Idu FK. Corn silk aqueous extracts and intraocular pressure of systemic and non-systemic hypertensive subjects. *Clin Exp Optom* 2015; 98:138–149
- Gobiec K, Konieczny Z. Receptariusz Zielarski, Wyd II. Zjednoczenie Przemysłu Zielarskiego Herbapol, 1963, p.191 (in Polish)
- Gruenwald J (Ed.) PDR for Herbal Medicines Fourth Edition. Thomson 2007, p.231
- Gumaih HS, Alasbahy A, Alharethi SH, Al-Asmari SM, Al-Khulaidi AWA. Antirolithiasis activities of *Zea mays* extract and its mechanism as antirolithiasis remedy. *Am J Clin Exp Urol* 2023; 11(5):443-451
- Guo H, Guan H, Yang W, Liu H, Hou H, Chen X, et al. Pro-apoptotic and anti-proliferative effects of corn silk extract on human colon cancer cell lines. *Oncol Letts* 2017; 13:973-978

- Guo Q, Ma Q, Xue Z, Gao X, Chen H. Studies on the binding characteristics of three polysaccharides with different molecular weight and flavonoids from corn silk. *Carbohydrate Polymers* 2018; 198:581-588
- Ha AW, Kang HJ, Kim SL, Kim MH, Kim WK. Acute and Subacute Toxicity Evaluation of Corn Silk Extract. *Prev. Nutr. Food Sci.* 2018; 23(1):70-76
- Haldar S, Gan L, Tay SL, Ponnalagu S, Henry CJ. Postprandial Glycaemic and Insulinemic Effects of the Addition of Aqueous Extracts of Dried Corn Silk, Cumin Seed Powder or Tamarind Pulp, in Two Forms, Consumed with High Glycaemic Index Rice. *Foods* 2019; 8, 437; doi:10.3390/foods8100437
- Ikpeazu VO, Ugbogu EA, Emmanuel O, Uche-Ikonne C, Okoro B, Nnaemeka J. Evaluation of the safety of oral intake of aqueous extract of stigma maydis (corn silk) in rats. *Acta Sci. Pol. Technol. Aliment.* 2018; 17(4), 387–397
- Informator Terapeutyczny do Urzędowego Spisu Leków 1959. Ministerstwo Zdrowia, Departament Farmacji. "CEFARM" Centrala Farmaceutyczna, Warszawa 1959, p. 540-541 (in Polish)
- Jia Y, Xue Z, Wang Y, Lu Y, Li R, Li N et al. Chemical structure and inhibition on α -glucosidase of polysaccharides from corn silk by fractional precipitation. *Carbohydrate Polymers*. 2021; 252:117185, doi: 10.1016/j.carbpol.2020.117185
- Kan A, Orhan I, Coksari G, Sener B. In-vitro neuroprotective properties of the Maydis stigma extracts from four corn varieties. *Int J Food Sci Nutr* 2012; 63(1):1–4
- Kashamar AM, Naser EH, Abu Almaali HA, Abbas IS. Clinical study of three medicinal plants (*Foeniculum vulgare*, *Zea mays*, and *Petroselinum sativum*) against urinary tract infection and stones. *J. Pharm. Sci. & Res. (India)* 2018, 10(4):755-758
- Kim S-L, Kim M-J, Lee Y-Y, Jung G-H, Son B-Y, Lee J-S et al. Isolation and Identification of Flavonoids from Corn Silk. *Korean J. Crop Sci.* 2014; 59(4):435-444
- Kim SR, Ha AW, Choi SL, Kang HJ, Kim MH, Kim WK. Corn silk extract improves benign prostatic hyperplasia in experimental rat model. *Nutr Res Pract* 2017;11(5):373-380
- Kruesi MJP. Corn Silk Tea and Enuresis. *J Child Adol Psychopharm* 2016; 26 (6): 569–570; DOI: 10.1089/cap.2012.0125
- Lee EY, Kim SL, Kang HJ, Kim MH, Ha AW, Kim WK. High maysin corn silk extract reduces body weight and fat deposition in C57BL/6J mice fed high-fat diets. *Nutr Res Pract* 2016; 10(6):575-582
- Limmatrapirat C, Nateesathittarn C, Dechasathian K, Moohummad T, Chinajitphan P, Limmatvapirat S. Phytochemical analysis of baby corn silk extracts. *J Ayur Inte Med* 2020; 11:344-351
- Maksimović Z, Dobrić S, Kovačević N, Milovanović Z. Diuretic activity of Maydis stigma extract in rats. *Pharmazie* 2004; 59:967-971
- Maksimović Z, Malenčić D, Kovačević N. Polyphenol contents and antioxidant activity of Maydis stigma extracts. *Bior Techn* 2005; 96:873–877
- Medicinal Plants in Viet Nam. WHO Regional Publications. Western Pacific Series No. 3. WHO Regional Office for the Western Pacific/Institute of Materia Medica Hanoi 1990, p.198
- Munkvold GP, Arias S, Taschl I, Gruber-Dorninger C. Mycotoxins in Corn: Occurrence, Impacts and Management. Chapter 9 in: Corn (Third edition). Chem Techn, 2019, pp.235-287
- Muszyński J, Ziółolecznictwo I leki roślinne (Fitoterapia). Wyd V. Państwowy Zakład Wydawnictw Lekarskich, Warszawa 1954, p.173 (in Polish)

- Naeem MM. Protective effect of Corn silk (*Zea mays* L.) in kidney and liver functions in rats. *Bull Nutr Inst Arab Rep Egypt* 2022; 60:122-153
- Newall CA, Anderson LA, Phillipson JD. Herbal Medicines, A Guide for Health-care Professionals. The Pharmaceutical Press London 1996, p.90
- Nwachuku OE, Briggs ON, Okike D, Brisibie N, Elekima I. Evaluation of Protective and Therapeutic Potentials of Aqueous Extract of Corn Silk on Gentamicin-Induced Nephrotoxicity in Albino Rats. *J Compl Alt Med Res* 2020; 11(4):13-23. Article no. JOCAMR.61894
- OECD 2016. Mammalian Bone Marrow Chromosomal Aberration Test. Guideline for the testing of chemicals. OECD/OCDE, 475 Adopted 29 July 2016. Available at: <http://www.oecd.org/termsandconditions/>
- Okunade M, Makinwa T, Mohammed F, Ibiyemi D. Effect of Aqueous Corn Silk (*Stigma maydis*) Extracts on Serum Electrolytes in Male Albino Wistar Rats. *J Biol, Agric Healthcare* 2015; 5(24): 11-16; www.iiste.org ISSN 2224-3208 (Paper) ISSN 2225-093X (Online)
- Orellana-Palacios JC, Garcia SR, Rabanal-Ruiz Y et al. Corn silk as an underutilized sustainable source of plant proteins: Extraction, fractionation, structure, and techno-functional properties. *Food Hydrocolloids* 2025, 150:110550 (<https://doi.org/10.1016/j.foodhyd.2024.110550>)
- Oyabambi AO, Areola ED, Olatunji LA, Soladoye AO. Uric Acid Is a Key Player in Salt-Induced Endothelial Dysfunction: The Therapeutic Role of *Stigma Maydis* (Corn Silk) Extract. *Appl Physiol, Nutr Metabol* 2020; p.1-24; <https://mc06.manuscriptcentral.com/apnm-pubs>
- Pan Y, Wang C, Chen Z, Li W, Yuan G, Chen H. Physicochemical properties and antidiabetic effects of a polysaccharide from corn silk in high-fat diet and streptozotocin-induced diabetic mice. *Carbohydrate Polymers* 2017; 164:370-378
- Pardede TR, Bachri M. Analysis on calcium solubility in kidney stones (in vitro) and diuretic effect (in vivo) using corn silk (*Zea mays* L.) infuse. *Asian J Pharm Clin Res* 2018; 11(1), online 2455-3891
- Peng KZ, Yang X, Zhou HL, Pan SX. Safety evaluation, *in vitro* and *in vivo* antioxidant activity of the flavonoid-rich extract from *Maydis stigma*. *Molecules* 2015, 20, 22102–22112; doi:10.3390/molecules201219835
- Peng KZ, Zhang S-Y, Zhou H-L. Toxicological evaluation of the flavonoid-rich extract from *Maydis stigma*: Subchronic toxicity and genotoxicity studies in mice. *J Ethnopharmacol* 2016; 192:161-169
- Pinheiro ACS, Pais AA, Tardivo ACB, Alves MJQF. Efeito do extrato aquoso de cabelo de milho (*Zea mays* L.) sobre a excreção renal de água e eletrólitos e pressão arterial em ratos Wistar anestesiados. *Rev. Bras. Pl. Med., Botucatu* 2011; 13(4):375-381 (in Portuguese)
- Ren S-C, Liu ZL, Ding XL. Isolation and identification of two novel flavone glycosides from corn silk (*Stigma maydis*). *J Med Plants Res* 2009; 3(12):1009-1015
- Ryuk JA, Ko BS, Moon NR, Park S. Protection against Neurological Symptoms by Consuming Corn Silk Water Extract in Artery-Occluded Gerbils with Reducing Oxidative Stress, Inflammation, and Post-Stroke Hyperglycaemia through the Gut-Brain Axis. *Antioxidants* 2022; 11, 168 <https://doi.org/10.3390/antiox11010168>
- Saheed S, Oladipio AE, Abdulazeez AA, Olarewaju SA, Ismaila NO, Emmanuel AA et al. Toxicological evaluations of *Stigma maydis* (corn silk) aqueous extract on haematological and lipid parameters in Wistar rats. *Tox Reps* 2015; 2:638-644

- Shi S, Li S, Li W, Xu H. Corn Silk Tea for Hypertension: A Systematic Review and Meta-Analysis of Randomized Controlled Trials. *E-Based Comp Alt Med* 2019; Article ID 2915498, <https://doi.org/10.1155/2019/2915498>
- Singh J, Inbaraj BS, Kaur S, Rasane P, Nanda V. Phytochemical analysis and characterisation of corn silk (*Zea mays*, G5417). *Agronomy* 2022; 12: 777. <https://doi.org/10.3390/agronomy12040777>
- Snook ME, Widstrom NW, Wiseman BR, Byrne PF, Haewood JS, Costello CE. New C-4''-Hydroxy Derivatives of Maysin and 3'-Methoxymaysin Isolated from Corn Silks. *J. Agric. Food Chem.* 1995; 43(10): 2740–2745 (Abstract)
- Solihah MA, Nurhanan AR, Wan Amir Nizam WA, Wan Rosli WI. Aqueous Extract of Cornsilk Confers Mild Diuretic Activity in Normal Rats. *Sains Malaysian* 2015; 44(8):1167–1174
- Suzuki R, Ijima M, Okada Y, Okuyama T. Chemical Constituents of the Style of *Zea mays* L. with Glycation Inhibitory Activity. *Chem. Pharm. Bull.* 2007; 55(1)153–155
- Suzuki R, Okada Y, Okuyama T. Two Flavone C-Glycosides from the Style of *Zea mays* with Glycation Inhibitory Activity. *J. Nat. Prod.* 2003a; 66:564–565
- Suzuki R, Okada Y, Okuyama T. A New Flavone C-Glycoside from the Style of *Zea mays* L. with Glycation Inhibitory Activity. *Chem. Pharm. Bull.* 2003b 51(10):1186–1188
- Suzuki R, Okada Y, Okuyama T. The Favorable Effect of Style of *Zea mays* L. on Streptozotocin Induced Diabetic Nephropathy. *Biol. Pharm. Bull.* 2005; 28(5):919–920
- The State Pharmacopoeia of the USSR, 11th ed., part 2, 1990. Medizina, Moscow
- Tian S, Sun Y, Chen Z. Extraction of Flavonoids from Corn Silk and Biological Activities *In Vitro*. *J Food Quality* 2021; Article ID 7390425; <https://doi.org/10.1155/2021/7390425>
- Veitch NC, Smith M, Barnes J, Anderson LA, Phillipson JD. Herbal Medicines, Fourth edition. London, Pharmaceutical Press 2013
- Vincelli P, Parker G. Fumonisin, Vomitoxin, and Other Mycotoxins in Corn Produced by Fusarium Fungi. UK Cooperative Extension Service, University of Kentucky, College of Agriculture. Agriculture & Natural Resources. Family & Consumer Sciences, 4-H/Youth Development. Community & Economic Development (guidance). Canada 2019
- Vranješ M, Popović BM, Štajner D, Ivetić V, Mandić A, Vranješ D. Effects of bearberry, parsley and corn silk extracts on diuresis, electrolytes composition, antioxidant capacity and histopathological features in mice kidneys. *J Funct Foods* 2016; 21:272–282
- Waiss AC Jr., Chan BG, Elliger CA, Wiseman BR, McMillian WW, Widstrom NW, Zuber MS, Keaster A J. Maysin, a Flavone Glycoside from Corn Silks with Antibiotic Activity Toward Corn Earworm. *J Econ Entomol* 1979; 72(2):256–258, <https://doi.org/10.1093/jee/72.2.256>
- Wang C, Yin Y, Cao X, Li X. Effects of Maydis stigma polysaccharide on the intestinal microflora in type-2 diabetes. *Pharm Biol* 2016; 54(12):3086–3092
- Wang C, Zhang TZ, Liu J, Lu S, Zhang C, Wang E et al. Subchronic toxicity study of corn silk with rats. *J Ethnopharmacol* 2011; 137:36–43
- Wang K-J & Zhao J-L. Corn silk (*Zea mays* L.), a source of natural antioxidants with α -amylase, α -glucosidase, advanced glycation and diabetic nephropathy inhibitory activities. *Biomed & Pharm* 2019; 110:510–517

- Wang X, Yuan L, Bao Z, Fu B, Jiang P, Ma T, Lin S. Screening of uric acid-lowering active components of corn silk polysaccharide and its targeted improvement on renal excretory dysfunction in hyperuricemia mice. *J Func Foods* 2021; 86:104698
- Wans EM, Ahmed MM, Mousa AA, Tahoun EA, Orabi SH. Ameliorative effects of corn silk extract on acetaminophen-induced renal toxicity in rats. *Environ Sci Poll Res* 2021; 28:1762–1774; <https://doi.org/10.1007/s11356-020-10588-4>
- Wei B-B, Chen Z-X, Liu M-Y, Wei M-J. Development of a UPLC-MS/MS Method for Simultaneous Determination of Six Flavonoids in Rat Plasma after Administration of Maydis stigma Extract and Its Application to a Comparative Pharmacokinetic Study in Normal and Diabetic Rats. *Molecules* 2017; 22, 1267; doi:10.3390/molecules22081267
- WHO monographs on medicinal plants commonly used in the Newly Independent States (NIS). World Health Organisation, 2010, p.423
- Wren RC (rewritten by Williamson EM). Potter's New Cyclopaedia of Botanical Drugs and Preparations. 1988. Saffron Walden The C.W. Daniel Company Limited, 1988, p.91
- Wyk B-E & Wink M. Medicinal Plants of the World, Timber Press 2004, p.348
- Yuan L, Bao Z, Ma T, Lin S. Hypouricemia effects of corn silk flavonoids in a mouse model of potassium oxonated-induced hyperuricemia. *J Food Bioch.* 2021;45:e13856; <https://doi.org/10.1111/jfbc.13856>
- Zhang H, Cao X, Liu Y, Shang F. Rapid recovery of high content phytosterols from corn silk. *Chem Centr J* 2017; 11:108; DOI 10.1186/s13065-017-0277-1
- Zhang Y, Wang J-B, Wang L, Zhen L-y, Zhu Q-q, Chen X-W. A study on hypoglycaemic health care function of Stigma maydis polysaccharides. *Afr J Tradit Compl Alt Med.* 2013; 10(5):401-407
- Zhang Y, Wo L, Ma Z, Cheng J, Liu J. Anti-Diabetic, Anti-Oxidant and Anti-Hyperlipidemic Activities of Flavonoids from Corn Silk on STZ-Induced Diabetic Mice. *Molecules* 2016; 21, 7; doi:10.3390/molecules21010007
- Zhou W-Y, Lin B, Hou Z-L, Shi S-C, Wang Y-X, Huang X-X, Song S-J. Isolation of macrocarpene-type sesquiterpenes from *stigma maydis* with neuroprotective activities. *Fitoterapia* 2020; 141:104448; <https://doi.org/10.1016/j.fi tote.2019.104448>
- Zhou W-Y, Niu J-Q, Du N-N, Li J-Y, Lin B, Yao G-D et al. Utilization of the By-Product of Corn: Guided Identification of Bioactive Terpenoids from Stigma Maydis (Corn Silk). *J Agric Food Chem* 2023; 71(7): 3338-3349 DOI: 10.1021/acs.jafc.2c08452