A Summary of 31 Mangosteen Studies

Introduction: Narace D. Seudeal, Ph.D. is a Ph.D. in Clinical Biochemistry who refuses to accept products without the research to back them up -- meaning actual clinical and scientific studies rather than weak tests that have no real relevance to the human condition. Mangosteen xanthones research is extensive and studied by Ph.D.'s, MD's, and other research scientists from around the world.

Dr. Seudeal reviewed 31 selections of mangosteen xanthones research articles and condensed the main conclusions in an easy-to-read format with the least technical jargon as possible, yet keeping the integrity of the medical findings intact.

Remember, this is just a sampling of xanthones research. For hundreds of years, Asian natives used the mangosteen fruit to treat a variety of sicknesses and conditions, without any clue as to the nature of the active ingredients in their concoctions using the mangosteen fruit or why they worked.

Today, because of the mangosteen xanthones research done worldwide, we can understand why the potions, preparations, and poultices used by the natives of Asia were effective enough to endure through time.

31 Mangosteen Research Studies

Summarized by Narace D. Seudeal, Ph.D.

1) Antiproliferation, antioxidation and induction of apoptosis by Garcinia mangostana (mangosteen) on SKBR3 human breast cancer cell line. J Ethnopharmacol. 2004 Jan;90(1):161-6. Moongkarndi P, Kosem N, Kaslungka S, Luanratana O, Pongpan N, Neungton N.Department of Microbiology, Faculty of Pharmacy, Mahidol University, Sri Ayudthaya Road, Rajdhevee, Bangkok 10400, Thailand. pypmk@mahidol.ac.th

> These investigators found that an extract from the pericarp of the mangosteen fruit **inhibited the growth of breast cancer cells.** They also showed that the extract had potent antioxidant and cancer cell death properties. They concluded that the extract from the pericarp of the mangosteen fruit has potential for chemoprevention.

2) Induction of apoptosis by xanthones from mangosteen in human leukemia cell lines. Matsumoto K, Akao Y, Kobayashi E, Ohguchi K, Ito T, Tanaka T, Iinuma M, Nozawa Y. Gifu International Institute of Biotechnology, 1-1 Naka-Fudogaoka, Kakamigahara, Gifu 504-0838, Japan. kmatsumoto@giib.or.jp

These authors examined the effects of six xanthones extracted from the pericarps of the mangosteen fruit, Garcinia mangostana, on the cell growth inhibition of human leukemia cell line HL60. **All xanthones displayed growth inhibitory effects.** Among them, alpha-mangostin (a xanthone) showed the most potent ability to cause the cancer cells death.

3) Antimycobacterial activity of prenylated xanthones from the fruits of Garcinia mangostana. Chem Pharm Bull (Tokyo). 2003 Jul;51(7):857-9. Suksamrarn S, Suwannapoch N, Phakhodee W, Thanuhiranlert J, Ratananukul P, Chimnoi N, Suksamrarn A. Department of Chemistry, Faculty of Science, Srinakharinwirot University, Bangkok, Thailand. sunit@swu.ac.th

Xanthones, isolated from the fruit hulls and the edible arils and seeds of Garcinia mangostana, mangosteen fruit, were tested for **their antituberculosis potential.** The investigators found alpha- and beta-mangostins and garcinone B exhibited strong inhibitory effect against Mycobacterium tuberculosis (TB).

4) Garcinone E, a xanthone derivative, has potent cytotoxic effect against the patocellular carcinoma cell lines. Planta Med. 2002 Nov;68(11):975-9. Ho CK, Huang YL, Chen CC. Department of Medical Research & Education, Veterans General Hospital, Taipei, ROC.

Treatment of hepatocellular carcinomas (liver cancer) with chemotherapy has generally been disappointing and it is most desirable to have more effective new drugs. The investigators extracted and purified 6 xanthone compounds from the rinds (peel) of the fruit of Garcinia mangostana, mangosteen fruit. The investigators tested this extract on 14 different human liver cancer cell lines. Several chemotherapeutic agents (drugs) were included in the study for comparison. The results showed that one of the xanthone derivatives which could be identified as garcinone E has **potent cytotoxic effect (kill cells) on all liver cancer cell lines as well as on the other gastric and lung cancer cell lines** included in the screen. The investigators suggested that garcinone E may be potentially useful for the treatment of certain types of cancer.

5) Inhibitions of histamine release and prostaglandin E2 synthesis by mangosteen, a Thai medicinal plant. Biol Pharm Bull. 2002 Sep;25(9):1137-41. Nakatani K, Atsumi M, Arakawa T, Oosawa K, Shimura S, Nakahata N, Ohizumi Y. Department of Pharmaceutical Molecular Biology, Graduate School of Pharmaceutical Sciences, Tohoku University, Sendai, Japan.

The fruit hull of mangosteen, Garcinia mangostana L., mangosteen fruit, has been used as a Thai indigenous medicine for many years. However, its mechanism of action as a medicine has not been elucidated. The present study was undertaken to examine the effects of mangosteen fruit extracts on histamine release and prostaglandin E2 synthesis. The investigators found the mangosteen fruit extract **strongly inhibited histamine release** and prostaglandin E2 synthesis. This has great importance in **preventing allergies**.

6) Inhibition of cyclooxygenase and prostaglandin E2 synthesis by gamma-mangostin, a xanthone derivative in mangosteen, in C6 rat glioma cells. Biochem Pharmacol. 2002 Jan 1;63 (1):73-9. Nakatani K, Nakahata N, Arakawa T, Yasuda H, Ohizumi Y. Department of Pharmaceutical Molecular Biology, Graduate School of Pharmaceutical Sciences, Tohoku University, Aoba, Aramaki, Aoba-ku, 980-8578, Sendai, Japan.

The fruit hull of mangosteen fruit, Garcinia mangostana L., has been used for many years as a medicine for treatment of **skin infection, wounds, and diarrhea** in Southeast Asia. In the present study, the investigators studied the effect of gamma-mangostin, a xanthone contained in the mangosteen fruit, and showed it had a potent inhibitory activity of prostaglandin E2 (PGE2) release.

7) Immunopharmacological activity of polysaccharide from the pericarp of mangosteen garcinia: phagocytic intracellular killing activities. J Med Assoc Thai. 1997 Sep;80 Suppl 1:S149-54. Chanarat P, Chanarat N, Fujihara M, Nagumo T. Department of Clinical Microscopy, Faculty of Associated Medical Sciences, Chiang Mai University, Thailand.

Polysaccharides from the pericarps of mangosteen, Garcinia mangostana Linn., mangosteen fruit, were extracted from the dried ground pericarps of the mangosteen fruit. The results showed that the number of S. enteritidis (bacteria) in cultured monocyte with extract of the pericarp of the mangosteen fruit was killed. This paper showed that polysaccharides in the extract can stimulate phagocytic cells to **kill intracellular bacteria** (S. enteritidis).

8) Histaminergic and serotonergic receptor blocking substances from the medicinal plant Garcinia mangostana. Planta Med. 1996 Oct;62(5):471-2. Chairungsrilerd N, Furukawa K, Ohta T, Nozoe S, Ohizumi Y.

The investigators studied an extract of the fruit hull of Mangosteen, Garcinia mangostana L., mangosteen fruit. On the basis of pharmacological data, they determined that alpha-mangostin and gamma-mangostin (xanthones in mangostana) are a histaminergic and a serotonergic receptor blocking agent, respectively. That is, they have the ability to **prevent allergies and inflammation.**

9) Inhibition of lipoprotein oxidation by prenylated xanthones derived from mangostin. Free Radic Res. 2000 Nov;33(5):643-59. Mahabusarakam W, Proudfoot J, Taylor W, Croft K. Chemistry Department, Prince of Songkla University, Hat Yai, Thailand.

Oxidative damage is thought to play a critical role in cardiovascular and other chronic diseases. This has led to considerable interest in the antioxidant activity of dietary compounds. The researchers have previously shown that the xanthone, mangostin (found in mangosteen fruit), can inhibit the oxidation of LDL, low density lipoprotein (bad cholesterol). Researchers studied more xanthone derived compounds and found **enhanced antioxidant activities**. Note: If the oxidation of LDL cholesterol can be prevented or inhibited, then the LDL-cholesterol cannot exert its "bad" effect and cause heart disease.

10) Plant-derived leading compounds for chemotherapy of human immunodeficiency virus (HIV) infection. Planta Med. 1998 Mar;64(2):97-109. Vlietinck AJ, De Bruyne T, Apers S, Pieters LA. Department of Pharmaceutical Sciences, University of Antwerp (UA), Belgium. vlietink@uta.ua.ac.be

The investigators showed many compounds of plant origin have been identified that **inhibit different stages in the replication cycle of human immunodeficiency virus (HIV).** Among these compounds, the xanthone mangostin, derived from mangosteen fruit, was shown to **inhibit the replication cycle of HIV**.

11) Novel types of receptor antagonists from the medicinal plant Garcinia mangostana. [Article in Japanese] Nippon Yakurigaku Zasshi. 1997 Oct;110 Suppl 1:153P-158P. Furukawa K, Chairungsrilerd N, Ohta T, Nozoe S, Ohizumi Y. Department of Pharmaceutical Molecular Biology, Faculty of Pharmaceutical Sciences, Tohoku University, Sendai, Japan.

Here the researchers used a crude extract of the fruit hull of Garcinia mangostana L, mangosteen fruit. On the basis of physicochemical data, the active substances were identified as alpha-mangostin and gamma-mangostin in the crude extract. The researchers found that alpha-Mangostin and gamma-mangostin may become novel types of lead compounds for histamine and serotonin receptor antagonists **(fight allergies and inflammation)**.

12) Pharmacological properties of alpha-mangostin, a novel histamine H1 receptor antagonist. Eur J Pharmacol. 1996 Oct 31;314(3):351-6. Chairungsrilerd N, Furukawa K, Ohta T, Nozoe S, Ohizumi Y. Department of Pharmaceutical Molecular Biology, Faculty of Pharmaceutical Sciences, Tohoku University, Sendai, Japan.

Researchers found that alpha-mangostin (found in the mangosteen fruit) blocked the binding of histamine to its receptors **(fight allergies and inflammation)**.

13) Antibacterial activity of xanthones from guttiferaeous plants against methicillin-resistant Staphylococcus aureus. J Pharm Pharmacol. 1996 Aug;48(8):861-5. Iinuma M, Tosa H,

Tanaka T, Asai F, Kobayashi Y, Shimano R, Miyauchi K. Department of Pharmacognosy, Gifu Pharmaceutical University, Japan.

The investigators showed that extracts of Garcinia mangostana, mangosteen fruit, possessed inhibitory effects against the growth of S. aureus (staph bacteria). The strong in-vitro **antibacterial activity** of xanthone derivatives against both methicillin-resistant and methicillin sensitive Staphylococcus aureus suggests the compounds might find wide pharmaceutical use.

14) Active constituents against HIV-1 protease from Garcinia mangostana. Planta Med. 1996 Aug;62(4):381-2. Chen SX, Wan M, Loh BN.

The investigators found that an extract of Garcinia mangostana L., mangosteen fruit, **showed potent inhibitory activity against HIV-1 protease which affects the replication of HIV.**

15) Mangostin inhibits the oxidative modification of human low density lipoprotein. Free Radic Res. 1995 Aug;23(2):175-84. Williams P, Ongsakul M, Proudfoot J, Croft K, Beilin L. University of Western Australia, Department of Medicine, Royal Perth Hospital, Australia.

The oxidation of low density lipoprotein (LDL) may play an important role in atherosclerosis. The researchers investigated the possible antioxidant effects of mangostin, isolated from Garcinia mangostana (found in mangosteen fruit), on the oxidation of human LDL (bad cholesterol). From these results, they concluded that **mangostin is acting as a free radical scavenger** ("mop up" sponge) to protect the LDL from oxidative damage in this in vitro system. In other words, it **a potent antioxdiant**.

16) Alpha-mangostin induces Ca(2+)-ATPase-dependent apoptosis via mitochondrial pathway in PC12 cells. J Pharmacol Sci. 2004 May;95(1):33-40. Sato A, Fujiwara H, Oku H, Ishiguro K, Ohizumi Y. Department of Pharmaceutical Molecular Biology, Graduate School of Pharmaceutical Sciences, Tohoku University, Sendai, Japan.

The researchers investigated the cell death effects of eight xanthones on pheochromocytoma (cancer) cells. Among these compounds, alpha-mangostin, from the fruit hull of Garcinia mangostana L. (mangosteen fruit), had **the most potent effect with apoptosis (death) of these cancer cells**.

17) Relationship between protective effect of xanthone on endothelial cells and endogenous nitric oxide synthase inhibitors. Bioorg Med Chem. 2003 Nov 17;11(23):5171-7. Jiang DJ, Hu GY, Jiang JL, Xiang HL, Deng HW, Li YJ. Department of Pharmacology, School of Pharmaceutical Sciences, Central South University, Changsha 410078, China.

The researchers found that xanthone preserved endothelial cells inhibited the increased adhesion of monocytes to endothelial cells induced by oxidized LDL. This is especially important in **preventing plaque formation and the subsequent blockage of arteries and heart disease**.

18) Xanthones as inhibitors of growth of human cancer cell lines and their effects on the proliferation of human lymphocytes in vitro. Bioorg Med Chem. 2002 Dec;10(12):3725-30. Pedro M, Cerqueira F, Sousa ME, Nascimento MS, Pinto M. Centro de Estudos de Quimica Organica, Fitoquimica e Farmacologia da Universidade do Porto, Faculdade de Farmacia, Porto, Portugal. madalena@ff.up.pt

Twenty-seven xanthones were assessed for their capacity to inhibit in vitro the growth of three human cancer cell lines, (breast cancer, renal cancer, melanoma). **Inhibition of growth of these cancer cell lines** depended on the type of xanthone used in the study.

19) Xanthones from the green fruit hulls of Garcinia mangostana. J Nat Prod. 2002 May;65(5): 761-3. Suksamrarn S, Suwannapoch N, Ratananukul P, Aroonlerk N, Suksamrarn A. Department of Chemistry, Faculty of Science, Srinakharinwirot University, Bangkok 10110, Thailand. sunit@psm.swu.ac.th

Researchers isolated three new xanthones, mangostenol (1), mangostenone A (2), and mangostenone B (3), from the green fruit hulls of Garcinia mangostana, mangosteen fruit. NB: There are about 200 naturally occurring xanthones. The mangosteen fruit (mangostana garcina) **possesses 40 of these xanthones** with **even more being discovered** via research.

20) Antihypertensive and vasorelaxing activities of synthetic xanthone derivatives. Bioorg Med Chem. 2002 Mar;10(3):567-72. Wang LW, Kang JJ, Chen IJ, Teng CM, Lin CN. School of Pharmacy, Kaohsiung Medical University, Kaohsiung, Taiwan 807, ROC.

The researchers studied a series of xanthones and related compounds. The antihypertensive (against high blood pressure) and vasorelaxing (relaxing of the blood vessels to prevent high blood pressure) activity of compounds on cardiovascular system was evaluated. All the compounds tested **exhibited effective hypotensive (lower blood pressure) activity** in anesthetized rats.

21) Antidiabetic activity of a xanthone compound, mangiferin. Phytomedicine. 2001 Mar;8 (2):85-7. Miura T, Ichiki H, Hashimoto I, Iwamoto N, Kato M, Kubo M, Ishihara E, Komatsu Y, Okada M, Ishida T, Tanigawa K. Suzuka University of Medical Science, Mie, Japan.

Mangiferin, a xanthone, **lowered the blood glucose (sugar) level in type II diabetic mice.** From these findings, it seems likely that mangiferin exerts its antidiabetic activity by decreasing insulin resistance.

22) Antiplatelets activity of some xanthone derivatives. Acta Pol Pharm. 1999 Jul-Aug;56(4): 319-24. Rajtar G, Zolkowska D, Kleinrok Z, Marona H. Department of Pharmacology and Toxicology, Medical University School, Lublin, Poland.

Researchers studied the effects of twelve xanthone derived compounds on platelet aggregation. They found five of them **inhibited thrombin-induced platelet aggregation (clot formation)**.

23) Chiral 2-amino-1-butanol xanthone derivatives as potential antiarrhythmic and hypotensive agents. Acta Pol Pharm. 1999 Jan-Feb;56(1):87-90. Librowski T, Czarnecki R, Jastrzebska M. Department of Pharmacodynamics, Collegium Medicum Jagiellonian University, Krakow, Poland. Cancer Lett. 1998 Oct 23;132(1-2):113-7. Xanthones as inhibitors of Epstein-Barr virus activation. Ito C, Itoigawa M, Furukawa H, Rao KS, Enjo F, Bu P, Takayasu J, Tokuda H, Nishino H. Faculty of Pharmacy, Meijo University, Nagoya, Japan.

Researchers screened 20 xanthones and found that 3 of them to have **valuable anti-tumor (against cancer) activities**.

24) Synthesis and anticonvulsant effects of some aminoalkanolic derivatives of xanthone. Pharmazie. 1998 Oct;53(10):672-6. Marona H. Department of Chemical Technology of Drugs, Collegium Medicum, Jagiellonian University, Krakow, Poland.

Researchers studied compounds derived from xanthone for anticonvulsant activities. They found several xanthone derived compounds to be **active in anticonvulsant tests**.

25) Mechanism of vasorelaxation of thoracic aorta caused by xanthone. Eur J Pharmacol. 1997 Oct 1;336(1):23-8. Cheng YW, Kang JJ. Institute of Toxicology, College of Medicine, National Taiwan University, Taipei.

The researchers showed vasorelaxation (**relaxing of blood vessels**) activity of the xanthones studied.

26) Xanthones as antimalarial agents; studies of a possible mode of action. FEBS Lett. 1997 Jun 2;409(1):67-73. Ignatushchenko MV, Winter RW, Bachinger HP, Hinrichs DJ, Riscoe MK. Department of Biochemistry and Molecular Biology, Oregon Health Sciences University, Portland 97201, USA.

Researchers showed **potent antimalarial activities** for the xanthones studied.

27) Synthesis and antithrombotic effect of xanthone derivatives. J Pharm Pharmacol. 1996 Sep;48(9):887-90. Lin CN, Hsieh HK, Liou SJ, Ko HH, Lin HC, Chung MI, Ko FN, Liu HW, Teng CM. School of Pharmacy, Department of Internal Medicine, Kaohsiung Medical College, Taiwan, R.O.C.

Researchers studied several xanthone derived compounds and found them to possess **potent antithrombotic (anti clotting) activities**.

28) Xanthone derivatives as potential anti-cancer drugs. J Pharm Pharmacol. 1996 May;48(5): 539-44. Lin CN, Liou SJ, Lee TH, Chuang YC, Won SJ. School of Pharmacy, Kaohsiung Medical College, Taiwan, Republic of China.

Researchers showed xanthone derived compounds to have **potent antitumor activities against human cancer cells**.

29) Synthesis and anti-inflammatory effects of xanthone derivatives. J Pharm Pharmacol. 1996 May;48(5):532-8. Lin CN, Chung MI, Liou SJ, Lee TH, Wang JP. School of Pharmacy, Kaohsiung Medical College, Taiwan, R.O.C.

The researchers studied 18 xanthone derived compounds and found that some of these compounds possessed **strong anti-inflammatory properties**.

30) Screening of unsubstituted cyclic compounds as inhibitors of monoamine oxidases. Biochem Pharmacol. 1994 Jun 15;47(12):2307-10. Thull U, Testa B. Institut de Chimie Therapeutique, Ecole de Pharmacie, Universite de Lausanne, Switzerland.

Of several compounds studied, xanthone emerged as **a potent monoamine oxidase inhibitor (MAOI)**.

31) Gamma-pyrone compounds as potential anti-cancer drugs. J Pharm Pharmacol. 1993 Sep;45(9):791-4. Liou SS, Shieh WL, Cheng TH, Won SJ, Lin CN. Natural Products Research Center, Kaohsiung Medical College, Taiwan, Republic of China.

Researchers studied several compounds and found xanthones with **enhanced anti-tumor activity against human cancer cell lines.**