Table S1. Traditional use of *S. asper*.

Plant part	Diseases treated	Other uses	References
Whole plant	Cardiac disorders, Epilepsy, Oedema, Leprosy, Dysentery Elephantiasis, Fever, Diarrhoea, Dysentery, Dysuria, Rheumatic pain, Toothache, Dental caries, Impotency	Disinfecting wounds Regulate tuberculous glands	Fiebig et al., 1985. Das & Beuria, 1991. Mia et al., 2009. Hossan et al., 2009
Bark		Induce immune response	Das & Beuria, 1991
Root	Epilepsy, Cardiac disorders, Oedema, Ulcers, Sinuses, Antidote to snakebite	Act on the myocardium	Gaitonde et al., 1964
Latex		The antiseptic and astringent agent applied on chapped hands, sore heels, and glandular swellings	Datta & Datta, 1984, Mukherjee & Roy, 1983
Leaf	Fever	Regulates blood pressure Reduce labor pain	Datta & Datta, 1984, Kadir et al., 2014, Sharkar et al., 2013, Lewis 1980, Kritsaneepaiboon, 1989,
Seed	Epistaxis, Piles, Diarrhoea		Datta & Datta, 1984, Kadir et al., 2014, Sharkar et al., 2013, Kritsaneepaiboon, 1989, Lewis, 1980
Twig	Pyorrhoea	Can act as a toothbrush, which could be chewed to clean the teeth	Datta & Datta, 1984, Kadir et al., 2014, Sharkar et al., 2013, Lewis 1980, Kritsaneepaiboon, 1989,

Table S2. The major phytoconstituents of *S. asper*.

Plant part	Analysis done	Phytochemicals	References
Stembark	Fractionation of the dichloromethane extracts over silica gel by gravity column chromatography.	Stebloside, Mansonin, Strophanthidin, Monoacetate	Fiebig et al., 1985
Leaves	Gas chromatography (GC) with Flame-ionization detection and GC-mass spectrometry (MS)	Phytol, α-farnesene, Trans-farnesyl acetate, Caryophyllene, Trans-trans-α-farnesene	Phutdhawong et al., 2004
Leaves	GC-MS analysis	Andrographolide, Carnosic acid, α-linolenic acid, Oleoyl oxazolopyridine	Prasansuklab et al., 2017
Leaves	GC-MS analysis	α-D-glucopyranoside, Glycerol, Myo-inositol, Butanedioic acid. Hexadecanoic acid, Octadecanoic acid, β-sitosterol, Lupenyl acetate, α-D-glucopyranoside.	Rawat et al., 2018

Table S3. Medicinal Properties of *S. asper*.

Property	Plant part	Extraction method	Model system	Dosage	Effects observed	References
Anti-cancer	Leaves	Hydro-distillation	Mouse lymphocytic leukemia (P388) cells	ED_{50} << 30 µg/ml	Volatile oils contained phytol, α-farnesene, trans-farnesyl acetate, caryophyllene and trans-trans-α-farnesene	Phutdhawong et al., 2004

Anti-cancer	Leaves and flowers	Methanol	Mouse lymphocytic leukemia (P388) cells		Activated anti-tumor activity	Ganu et al., 1991
Anti-cancer	Stembark	Methanol	Molecular docking and human ovarian cancer cells	100 nM	Inhibition of ovarian cancer cells including OVCAR3, OVSAHO, Kuramochi, OVCAR4, OVCAR5, and OVCAR8. Inhibited mutant p53 expression through the induction of ERK pathways and inhibited NF-κB activity. Blocked cell cycle progression at the G2 phase and induced PARP cleavage, indicating apoptosis activation in OVCAR3 cells	Chen et al., 2017
Anti-cancer	Stembark	Methanol	NCr nu/nu mice with MDA-MB-231 human breast or OVCAR3 human ovarian cancer cells	5-30 mg/kg	Inhibition of cell growth in a dose-dependent manner	Ren et al., 2017
Anti-cancer	-	Methanol	Cancer cell line (A549)	100 mM	High cell viability by inhibition on melanogenesis with melanin content by suppressing the protein expressions of TRP-2 and tyrosinase	Miao et al., 2018
Anti-cancer	Leaves	Methanol extraction and fractionated using hexane, chloroform, and butanol	Human lung cancer cell line (A-549), Hep-G2 cancer cell line, K-562 cancer cell line	10 µg/ml	All fractions were highly effective against A-549 with IC_{50} <10 µg/ml. The chloroform fraction was highly active with IC_{50} <10 µg/ml in Hep-G2 Methanol and hexane fraction showed potent anticancer activity on K-562 with IC_{50} <10 µg/ml.	Rawat et al., 2018
Antioxidant	Leaves	Aqueous	*In vitro*	-	Antioxidant activity against Hydrazyl radical, Nitric oxide radical, Hydroxyl radical and Superoxide radical which was compared with standard antioxidant ascorbic acid	Choudhury et al., 2009
Antioxidant	-	Methanol	*In vitro*	116.05, 110.07, 130.49, and143.99 µg/ml	DPPH radical scavenging, lipid peroxidation inhibition, hydroxyl radical scavenging, and nitric oxide scavenging activity were observed	Kakoti et al., 2007

Antioxidant	Leaves	Water or ethanol extraction	*In vitro*	0 to 1 mg/ml	High DPPH radical scavenging activity. Ethanol extracts showed higher phenolic and flavonoid contents.	Ibrahim et al., 2013
Antioxidant	Leaves	Ethanol extracts	*In vitro*	-	Acidic fraction possessed the strongest antioxidant potential in DPPH and ABTS	Prasansuklab et al., 2018
Antioxidant	-	Methanol	*In vivo*	250 and 500 mg/kg	Significantly increased the levels of CAT and GSH when compared to control. Reduced the level of TBARS. Restored the serum biochemical parameters, transaminases, phosphatases, and total bilirubin level	Kakoti et al., 2007
Antioxidant	Leaves	Aqueous	H_2O_2-treated SK-N-SH cells	200, 600, and 1000 μg/ml	Decreased the intracellular ROS levels	Singsai et al., 2015
Antibacterial	Leaves	Ethanol	*In vitro*	250 and 500 mg/ml	Anti-bacterial activity against *Porphyromonas gingivalis* W50, *Prevotella intermedia*, *Actinomyces naeslundii* (T14V), *Peptostreptococcus micros*, *Actinobacillus actinomycetemcomitans* ATCC 43718	Taweechaisupapong et al., 2005a
Antibacterial	Leaves	Acidic fraction of ethanolic extract	*In vitro*	125 µg/mL (MIC)	Antibacterial activity against *S. aureus* and *B. subtilis*	Prasansuklab et al., 2018
Antibacterial	Leaves or bulbs	Methanol	*In vitro*	-	Antibacterial activity against *Staphylococcus aureus* and *Salmonella typhi*	Mahida & Mohan, 2006
Antibacterial	Leaves	Aqueous, ethanol and methanol	*In vitro*	125, 250 and 250 µg/ml (MIC)	Antibacterial activity against *Streptococcus agalactiae*	Rattanachaikunsopon & Phumkhachorn, 2009
Antibacterial	Leaves	Aqueous, petroleum ether, ethyl acetate and methanol	*In vitro*	-	Anti-bacterial activity against *Staphylococcus epidermidis* MICC 2639, *Enterococcus faecallis* MTCC 439, *Salmonella paratyphi* MTCC 735, *Shigella dysenteriae*, *Mycobacterium tuberculosis* H 379 and *Candida albicans* MTCC 227	Arulmozhi et al., 2018
Antibacterial	Lignans from roots	Methanol extract fractionated into petroleum ether and ethyl acetate	*In vitro*	-	Antibacterial activity against *Saccharomyces cerevisiae* (ATCC 9763), *Bacillus subtilis* (ATCC 6633), *Pseudomonas aeruginosa* (ATCC 9027), *Escherichia coli* (ATCC 11775), *Staphylococcus aureus* (ATCC 25923)	Nie et al., 2016

Antibacterial	Leaves	Ethanol	*In vitro* Biofilm formation	90 mg/ml	Anti-biofilm activity in subgingival plaque samples from periodontitis patients cultivated in saliva-coated microtiter plates	Taweechaisupapong et al., 2014
Antibacterial		Aqueous	*In vitro*	-	Anti-bacterial activity against supra-gingival plaque causing bacteria	Rao et al., 2014
Anti-fungal	Leaves	Ethanol	Human buccal epithelial cells	125 and 250 mg/ml	41 and 61% inhibition of germ tube formation. Reduce the adhesion of fungal cells to the epithelial cells	Taweechaisupapong et al. 2005b
Anti-fungal	Leaves	Ethanol	Acrylic strips	62.5 and 125 mg/ml	Reduced the adhesion of *Candida* species in acrylic strips by almost 80%	Taweechaisupapong et al., 2006a
Oral hygiene	Sticks and leaves	Ethanol	*In vitro*		Inhibit the growth of *Streptococcus mutans*	Triratana & Thaweboon, 1987
Oral hygiene	Leaves	Ethanol	*In vitro*	30 mg/ml	A short (2 min) treatment with the extract could reduce the number of *S. mutans* in the oral cavity, thereby reducing the chances of dental caries	Wongkham et al., 2001
Oral hygiene	Stem bark	Ethanol	*In vitro*	-	Reduced the number of *S. mutans* in combination with other extracts	Joycharat et al., 2012
Oral hygiene	Leaves	Ethanol	*In vitro*	30 mg/mL	Reduce the number of *S. mutans* in the oral cavity	Wongkham et al., 2001
Oral hygiene	Bark	Ethanol	*In vitro*		Inhibit the growth of *Streptococcus intermedius*	Phumat et al., 2018
Anti-parasitic	Leaves	Aqueous	*In vitro*	5, 50, 500 and 1000 µg/ml	Moderate activity against *Trypanosoma evansi*, the causative agent of surra in animals	Talakal et al.,1996
Anti-Macrofilaricidal	stem bark		*In vitro*	10 µg/ml	At higher concentrations, both glycosides were able to cause the death of parasites and lower doses inhibited the glucose uptake, glutathione metabolism and motility	Singh et al., 1998; Singh et al., 1994
Neuroprotection	Leaves	Ethanol	HT22 cells	50 µg/mL	Reduce the level of oxidative stress and intracellular ROS induced by glutamate.	Prasansuklab et al., 2017
Neuroprotection	Leaves	Basic and Neutral fractions of ethanolic extract	*In vitro*		The fractions exhibited a cholinesterase inhibitory effect indicating the possibility to ameliorate AD	Prasansuklab et al., 2018
Neuroprotection	Leaves	Ethanol	*C. elegans*	10-30µg/ml	Extended the lifespan and reduced paralysis of Aβ transgenic strain	Prasanth et al., 2021

Anti-Hepatitis	Lignans from the heartwood	Methanol	Hep G2.2.15 cell lines	-	Inhibit the secretion of HBV surface antigen (HBsAg) and HBV e-antigen (HBeAg) with low or no cytotoxicity	Li et al., 2012a; 2012b
Anti-Hepatitis	Heartwood, bark, and roots	Methanol	Hep G2.2.15 cell lines	-	Inhibitions were ranging from 14.1% to 64.7%, 15.1% to 65.9% and 16.0% to 66.5%, respectively for HBsAg with low or no cytotoxicity	Chen et al., 2012
Anti-inflammatory	Leaves	Ethanol	RAW 264.7	0-6 mg/ml	Suppression of LPS-induced expression of COX-2 and iNOS	Sripanidkulchai et al., 2009
Anti-aging	Leaves	Ethanol	*C. elegans*	25, 50, 100 and 500 µg/ml	Extend the survival of the nematode	Prasansuklab et al., 2017
Anti-aging	Leaves	Ethanol	*C. elegans*	10-30µg/ml	Extended the lifespan and activated anti-aging mechanism via MAPK and SKN-1	Prasanth et al., 2021
Neuroprotection	Leaves	Aqueous	C57BL/6	200 mg/kg	Antagonize the motor and cognitive function deficits induced by MPTP (toxin responsible for Parkinson's)	Singsai et al., 2015
Neuroprotection	Stembark	n-hexane and dichloromethane fractions	BALB/c mice	400 mg/kg	Antidepressant activity. Dose-dependent diminution of epileptic seizures through GABArgic mechanism of anticonvulsant action	Verma et al., 2016
Anti-diabetic	Leaves	Petroleum ether	Diabetic rats	100, 250 and 500 mg/kg	Reduction of the fasting blood sugar levels along with restoration of glycolytic and gluconeogenic enzyme activities, glycogen content and insulin level	Choudhury et al., 2012
Anti-diabetic	Roots	Petroleum ether	Alloxan-induced diabetic mice	250 mg/kg	Reduce the blood glucose level	Karan et al., 2012
Anti-diabetic	Root bark	Methanol	Rats	200 and 400 mg/kg	Lower the blood glucose levels	Kumar et al., 2012
Anti-diabetic	Stembark	Petroleum ether	diabetic rats	100, 250 and 500 mg/kg	Reduced the glycosylated hemoglobin (HbA1c) levels along with increased the level of insulin	Karan et al., 2013
Anti-inflammatory	Leaves	Ethanol	Rats	500 mg/kg	Dose-dependent inhibition of edema, similar to the standard anti-inflammatory drug diclofenac	Sripanidkulchai et al., 2009
Anti-diarrheal	Leaves	Methanol	Swiss albino rats	100, 200 and 400 mg/kg	Reduced the total number of diarrheal feces in a dose-dependent manner	Shahed-Al-Mahmud et al., 2020
Antioxidant	Rootbark	Methanol	Rats	200 and 400 mg/kg	Control the blood sugar levels	Kumar et al., 2012
Antioxidant	Stembark	Methanol	Swiss albino mice with Ehrlich ascites carcinoma	200 and 400 mg/kg	Modulated the hepatic and renal antioxidant parameters	Kumar et al., 2013a

Anti-cancer	Stembark	Methanol	Swiss albino mice with Ehrlich ascites carcinoma	200 and 400 mg/kg	Lifespan extension and anti-tumor activity	Kumar et al., 2013a
Anti-cancer	Bark	Ethyl acetate fraction of the methanol extracts	Swiss albino mice with Dalton's ascitic lymphoma	200 and 400 mg/kg	The extended survival rate in animals subjected to plant extracts. A significant and dose-dependent decrease in tumor growth parameters including weight, volume, and cell count. Restored the RBC, WBC, and haemoglobin count	Kumar et al., 2015
Anti-Macrofilaricidal	Stembark	Aqueous	Rodents	50 mg/kg	Reduce the population of microfilariae	Chatterjee et al. 1992
Oral hygiene	Leaves	Ethanol extract dissolved in distilled water	A clinical trial with 30 healthy subjects	80 mg/ml	Reduction in *S. mutans* counts without changing the oral ecology or the salivary pH	Taweechaisupapong et al. 2000
Oral hygiene	Leaves		A clinical trial with 42 subjects with chronic periodontitis	80 mg/ml	Subgingival irrigation was done with the extracts	Taweechaisupapong et al. 2002
Oral hygiene	Leaves	Ethanolic and Aqueous extract	A clinical trial with 76 subjects with moderate gingival inflammation		The extract could exhibit a significant effect on gingival health without having a significant effect on plaque growth	Gunjan et al., 2020

DPPH: 2,2-diphenyl-1-picrylhydrazyl, ED_{50}: Effective dose, ERK: Extracellular-signal-regulated kinase, IC_{50}: Half-maximal inhibitory concentration, RBC: Red blood cells, WBC: White blood cells, ABTS: (2,2'-azino-bis (3-ethylbenzothiazoline-6-sulfonic acid), CAT: Catalase, GSH: Glutathione, TBARS: Thiobarbituric acid reactive substances, ROS: Reactive oxygen species, MIC: Minimum inhibitory concentration, AD: Alzheimer's disease, MPTP: 1-methyl-4-phenyl-1,2,3,6-tetrahydropyridine, GABA: Gamma-Aminobutyric acid, HBV: Hepatitis B virus, LPS: Lipopolysaccharide, COX-2: Cyclooxygenase-2, iNOS: Inducible Nitric Oxide Synthase, MAPK: Mitogen-activated protein kinase, SKN-1: skinhead 1.

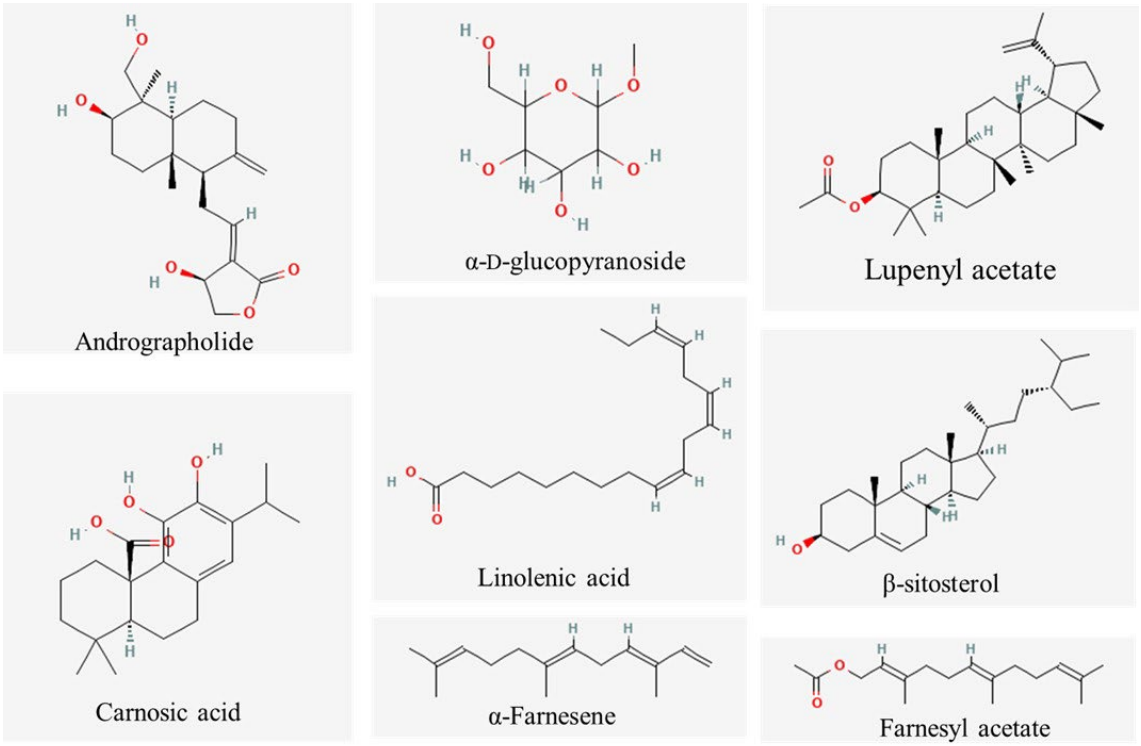

Figure S1. The major phytochemicals of *S. asper* (Andrographolide, carnosic acid, α-D-glucopyranoside, linolenic acid, α-farnesene, lupenyl acetate, β-sitosterol, and farnesyl acetate). The chemical structures were adapted from PubChem, National Center for Biotechnology Information (https://pubchem.ncbi.nlm.nih.gov/).

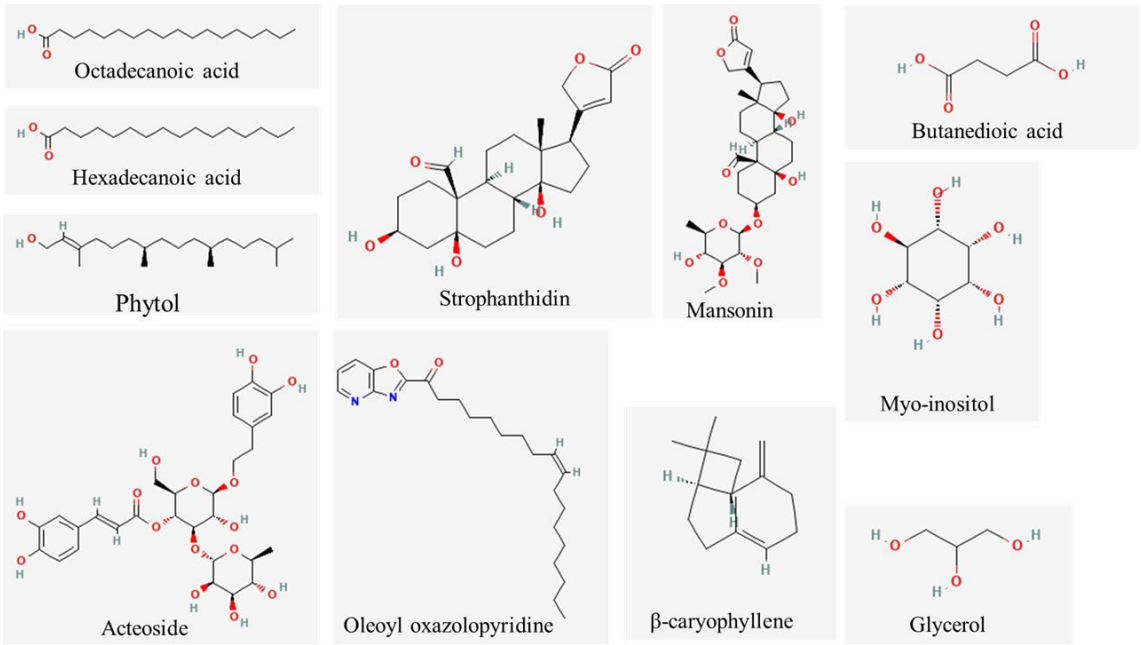

Figure S2. The major phytochemicals of *S. asper* (Octadecanoic acid, hexadecanoic acid, phytol, acteoside, strophanthidin, oleoyl oxazolopyridine, mansonin, β-caryophyllene, butanedioic acid, myo-inositol, and glycerol). The chemical structures were adapted from PubChem, National Center for Biotechnology Information (https://pubchem.ncbi.nlm.nih.gov/).