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Phytomedicinal uses of saponin containing herbs

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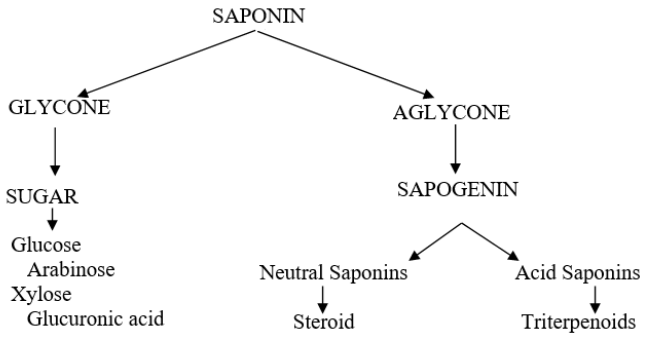
Abstract
Background: Saponins are a diverse family of secondary metabolites. Saponins are phytochemicals that produce a foam when dissolved in water. Their name derives from the same root as the word latin *sapo* it means soap. The unique chemical structure of saponins allows them to offer a number of prospective health benefits. Many plants used in traditional medicines worldwide contain saponins, which can often account for their therapeutic action. It is believed that the natural role of these compounds in plants is to protect against attack by potential pathogens, which would account for their antimicrobial activity and have a favorable effect on cholesterol. The wide chemical diversity of saponins has resulted in renewed interest.
Objective: To explore the wonderful phytochemical Saponin medicinal plants contain Saponins as *Shatavari*(Asperagus *racemosus), Arjuna(Terminalia arjuna), Madanphala(Randia spinosa), Gokshura(Tribulus terrestris), Ashoka (Saraca asoca), Aristaka (Sapindus trifoliatus)* etc.
Material & Method: In the present study, we collected and compiled references regarding *Ayurvedic* classical texts, previous work, research papers, review articles and google scholars etc.
Discussion & Conclusion: The current review focuses on properties of Saponins and medicinal plants which contain Saponins. Many plant drugs and folk medicines contain saponins that are found to have several kinds of bioactivities, such as antiviral, anti-inflammatory, antipara-sitic, immune-enhancing, anti-cancer, antimicrobial activities and may even support bone strength. This review provides a summary of saponin research.

Keywords: saponins, it's pharmacological properties and contain medicinal plants

Introduction
Saponins are an important group of plant secondary metabolites that are widespread throughout the plant kingdom. Saponins are basically phyto-chemicals which are found in most of the vegetables, beans and herbs. The Saponin derive from the Latin word "sapo" meaning soap, due to their surfactant properties, which allows forming stable soap-like foam when shaken in aqueous solution. True to its name, the root of the Saponaria, or soapwort plant, has been traditionally used as soap [1]. Like soaps or detergents, saponins are large molecules containing a water-loving (*hydrophilic*) part at one end separated from a fat-loving (*lipophilic* or *hydrophobic*) part at the other. In aqueous solution, saponin molecules align themselves vertically on the surface with their hydrophobic ends oriented away from the water. This has the effect of reducing the surface tension of the water, causing it to foam. For this reason, Saponins are naturally occurring surface-active agent produced by plants, lower marine animals, and some bacteria. Saponins occur constitutively in a great many plant species. Similar to other surface-active agents, saponin molecules can align to form a spherical configuration within the water, creating a micelle. Micelles have a lipophilic centre, and this creation of a fat-loving compartment explains why detergents can dissolve grease and oils. The action of saponins on the cardiovascular, central nervous, and endocrine systems and other miscellaneous effects are also discussed.

Classification of Saponin
There are two classes of Saponins are recognised based on the structure of their aglycone or sapogenin. Both of these have a glycosidic linkage, usually at carbon 3, and share a common biosynthetic origin via the mevalonic acid pathway [3]. Triterpenoid saponins are by far the most common. Both steroid & Triterpene types usually found existing together. In plants saponins are found especially in plant skins where they form a waxy protective coating. It has also been found that saponins are a major part of the plants' active immune system and function as a "natural antibiotic" for plants. There are some unusual classifications; for example, the ginsenosides in ginseng are grouped with the triterpenoid saponins even though they exhibit a steroidal structure. Steroidal saponins typically contain extra furan and pyran heterocyclic rings, which is not a feature of the ginsenosides. (Furans and pyrans are respectively five and six-membered rings containing oxygen.)
Steroidal saponins contain the characteristic four-ringed steroid nucleus. Steroidal saponins are mainly found in the monocotyledons. The chemical structure of Steroidal saponins is similar to that of many of the body's hormones, for example estrogen and cortisol, and many plants containing them have a marked hormonal activity. Their aglycone portion is referred to as the sapogenin. Ex.- The steroidal saponins in *Dioscorea villosa* (Wild Yam) were the basis from which the

contraceptive pill was first developed and currently many bioidentical hormones. Triterpenoid saponins have a five-ringed structure. Triterpenoid saponins have less hormonal activity. They are often expectorant and will aid absorption of nutrients.



Chemically they are based on a Steroid or Triterpene fat-soluble base joined to a water-soluble sugar molecule, creating a detergent that results in the emulsification of fat-soluble molecules in the digestive tract of the body. Among the chemical properties of saponins, their polarity, hydrophobicity and nature of the reactive groups seem important determinants of their biological properties, and has also made them difficult compounds to both isolate and research. Over one hundred families of plants contain saponins and there are more than eleven classes of saponins including dammaranes, tirucallanes, lupanes, hopanes, oleananes, taraxasteranes, ursanes, cycloartanes, lanostanes, cucurbitanes, and steroids [2]. It's believed many other varieties of saponins remain undiscovered.

Health Benefits of Saponins

These secondary metabolites often occur in plants as complex mixtures, and saponin content and composition may vary markedly depending on the genetic background of the plant material, the tissue type, the age and physiological state of the plant and environmental factors. Saponins have been variously attributed with a diverse range of properties, some of which include both beneficial and detrimental effects on human health, pesticidal, insecticidal and molluscicidal activity, allelopathic action, antinutritional effects, sweetness and bitterness, and as phyto-protectants that defend plants against attack by microbes and herbivores. Saponins have a unique chemical structure that produces foam when mixed with water, just like a detergent. And, also like detergent, saponins can bind with water as well as fats and oils. This means that, in the digestive tract, saponins produce an emulsification of fat-soluble molecules. Specifically, saponins bind to bile acids and help eliminate them from the body, preventing cholesterol from being reabsorbed. You might even say saponins "wash away" various toxins.

Pharmacological Properties of Saponins

Antihyperlipidemic activity

Saponins seem to help promote normal cholesterol levels. The body uses cholesterol to produce the bile necessary for digestion. Saponins bind with bile form mixed micelles with cholesterol, facilitating its absorption and prevent cholesterol from being reabsorbed back into the bloodstream; rather, it's simply excreted. When you eat, bile acids are released into your intestines. The detergent qualities of saponins allow them to bind to bile and prevent its reabsorption. Once bound to saponins, cholesterol leaves your body in waste. Cholesterol-lowering modern medications perform the same role, and over time excretion of bile may help lower your cholesterol. A lower cholesterol level means less risk of heart attack or stroke. The binding of bile acids by saponins has other important implications, as primary bile acids are metabolized by bacteria in the colon, producing secondary bile acids which can be promoters of colon cancer.

An animal study found that saponins may reduce cholesterol absorption [4]. And other one separate study found that giving a certain saponin extract to rats with high cholesterol reduced "bad" (LDL) cholesterol without affecting "good" (HDL) cholesterol [5]. For example, saponin fractions from garlic or ginseng were shown to decrease total and LDL cholesterol plasma concentrations without changing HDL cholesterol levels in hypercholesterolemic animal models.

Hypoglycemic activity

The saponins present in fenugreek are responsible for hypoglycemic activity either by stimulating the ß-cells or by suppressing the transfer of glucose from the stomach to the small intestine and the inhibition of glucose transport across the brush border of the small intestine.

The saponin momordin Ic was found to significantly and dose-dependently inhibit gastric emptying. The inhibition of gastric emptying may be inhibited by the release and/or production of dopamine to act through D2 receptors, which in turn causes the release of prostaglandins.

Boost the Immune System

In nature, plants rely on saponins as a mechanism to fight parasites. Similarly, when consumed by humans, saponins provide a similar defense against harmful organisms. One study demonstrated this action against Candida cells, specifically [6]. In another study, a specific type of saponin was observed to have antimicrobial activity that favorably influenced oral health [7]. The saponins show the antimicrobial activity by inhibiting the growth of Gram +ve or Gram -ve microorganism. Some saponins are not effective against Gram –ve micro-organisms because of the reason that they are not able to penetrate into the cell membranes of the microorganisms.

Eating more saponins may boost your immune function and fight off fungal infections, according to an article published in "ACS Chemical Biology" in March 2010. The study noted that saponins cause death of fungal cells, such as Candida albicans, which is responsible for yeast infections, thrush and many hospital-acquired infections. Saponins appear to enhance your immune system's ability to fight off viruses and parasites as well. Pharmaceutical manufacturers often include saponins in vaccines to increase their effectiveness.

Anticarcinogenic activity

Saponins have several qualities that act against cancer cells. In particular, some saponins have an antioxidant effect [8] and may be directly toxic to cancer cells. Cancer cell membranes

have cholesterol-type compounds. Like cholesterol, saponins are able to bind with these compounds and disrupt the proliferation of cancer cells. According to an article published in the *Journal of Nutrition*, saponins from soybeans may slow the growth of cancer cells. Other studies have reported saponins have induced the death of cancer cells and slowed tumor growth [9]. These plant compounds may also cause the death of tumor cells, according to an article published in the journal "Phytochemistry Reviews" in June 2010. The exact mechanism of these cell deaths varies depending on the source and dose of saponins. The proposed mechanism of anti-carcinogenic properties of saponins include antioxidant effect, direct and select cytotoxicity of cancer cells, immune-modulation, acid and neutral sterol metabolism and regulation of cell proliferation.

Other Major Actions of Saponins

A number of investigation into saponins have yielded a number of other, interesting revelations about their qualities. Preliminary research study done & concluded that -

- **Anti depressent -** Saponins from *Terminalia arjuna* (arjun tree) may offer a therapeutic benefit for kidney or urinary stones [10]. In a 2015 issue of *Natural Products Research*, it was noted that, in the past ten years, several preclinical reports have suggested that saponins may offer hope as a natural solution for depression [11].
- **Stimulating expectorant –** By effect via activation of mucociliary escalator and mucous membrane irritation.
- **Hepatoprotective property -** Other positive qualities of saponins include supporting Kupffer cells in the liver and encouraging normal detoxification. Hepatoprotective providing Kuppfer cell support in the liver promoting detoxification.
- **Diuretic property –** By effect via local irritation of kidney epithelia.
- **Gentle Detoxifiers –** By eliminating toxic buildup in various ways throughout the body.
- **Adaptogen** (or Adrenal tonic effect) & Hormone modulating - By mimicing our endogenous hormones and specifcally sparing cortisol.
- **As a bone toner** - Saponins found in oats and spinach support digestion by accelerating the body's ability to absorb calcium and silicon. In animal studies, saponins have been found to promote balanced blood sugar and support normal bone density [12].

Toxicity Effects

Some plant saponins (e.g. from oat and spinach) may enhance nutrient absorption and aid in animal digestion. However, saponins are often bitter to taste, and so can reduce plant palatability (e.g., in livestock feeds), or even imbue them with life-threatening animal toxicity. Some saponins are toxic to cold-blooded animals and insects at particular concentrations, their oral toxicity to mammals is low [13, 14].

Saponins can have an irritating effect on mucous membranes of the respiratory and digestive tract, potentially causing sneezing, bloating, gastroenteritis, nausea, diarrhea, and vomiting. Saponins have also been noted for their hemolytic properties as they can effectively "dissolve" the cell walls of red blood cells and disrupt them when taken intravenous or intramuscularly. When take orally however they are comparatively harmless or they are not absorbed at all. Any markedly toxic saponin is known as a sapotoxin.

Saponins Containing Medicinal Herbs

Saponins are a component in over a hundred different types of plants and foods including beans, chickpeas, peanuts, quinoa, and soy. Saponins exist in nightshade vegetables like tomatoes. It also occur in many plant species, in both wild plants and cultivated crops. In cultivated crops the triterpenoid saponins are generally predominant, while steroidal saponins are common in plants used as herbs or for their health-promoting properties. Triterpenoid saponins have been detected in many legumes. The well known sources of saponins are soybeans, peas, and some herbs with the names that indicate foaming properties such as soapwort, soapberry, soapbark and soap root. These are some *Ayurvedic* medicinal herbs that contain Saponin & they have potent medicinal values.

S.N.	Sanskrit name	Latin name	Family	*Rasa*	*Guna*	*Vipaka*	*Virya*
1	*Shatavari*	*Asparagus racemosus*	*Liliaceae*	*Madhura, Tikta*	*Guru, Snigdha*	*Madhura*	*Sheeta*
2	*Madanphala*	*Randia spinosa*	*Rubiaceae*	*Kashaya, Madhura, Tikta, Katu*	*Laghu, Ruksha*	*Katu*	*Ushna*
3	*Meshshrangi*	*Gymnema sylestre*	*Asclepiadaceae*	*Kashaya, Tikta*	*Laghu, Ruksha*	*Katu*	*Ushna*
4	*Aendri*	*Bacopa monnieri*	*Scrophulariaceae*	*Tikta*	*Laghu*	*Katu*	*Ushna*
5	*Tivrata*	*Operculina turpethum*	*Convolvulaceae*	*Tikta, Katu*	*Laghu, Ruksha, Tekshna*	*Katu*	*Ushna*
6	*Vetas*	*Salix caprea*	*Salicaceae*	*Kashaya, Tikta*	*Laghu*	*Katu*	*Sheet*
7	*Kakodumbar*	*Ficus hispida*	*Urticaceae*	*Tikt, Kashaya*	*Ruksha, Laghu*	*Katu*	*Sheet*
8	*Bharangi*	*Clerodendrum serratum*	*Verbenaceae*	*Tikta, Katu*	*Laghu, Ruksha*	*Katu*	*Ushna*
9	*Bakul*	*Mimusops elengi*	*Sapotaceae*	*Kashaya, Katu*	*Guru*	*Katu*	*Sheet*
10	*Kalambaka*	*Coscinium fenestratum*	*Menispermaceae*	*Tikta*	*Laghu, Ruksha*	*Katu*	*Ushna*
11	*Apamarga*	*Achyranthes aspera*	*Amaranthaceae*	*Katu, Tikta*	*Laghu, Ruksha, Tekshna*	*Katu*	*Ushna*
12	*Putrajevak*	*Putranjiva roxburghii*	*Euphorbiaceae*	*Madhura, Katu*	*Guru, Pischil*	*Madhura*	*Sheet*
13	*Kebuka*	*Costus speciosus*	*Zingiberaceae*	*Tikta, Kashaya*	*Laghu, Ruksha*	*Katu*	*Sheet*
14	*Ashoka*	*Saraca asoca*	*Leguminosae*	*Kashaya, Tikta*	*Laghu, Ruksha*	*Katu*	*Sheet*
15	*Patha*	*Cissampelos pareira*	*Menispermaceae*	*Tikta*	*Laghu, Tekshna*	*Katu*	*Ushna*
16	*Lodhra*	*Symplocos racemosa*	*Symplocaceae*	*Kashaya*	*Laghu, Ruksha*	*Katu*	*Sheet*
17	*Gokshura*	*Tribulus terrestris*	*Zygophyllaceae*	*Madhura*	*Guru, Snigdha*	*Madhura*	*Sheet*
18	*Varuna*	*Crataeva nurvala*	*Capparidaceae*	*Tikta, Kashaya*	*Laghu, Ruksha*	*Katu*	*Ushna*
19	*Siresha*	*Albizzia lebbeck*	*Fabaceae*	*Kashaya, Tikta, Madhur*	*Laghu, Ruksha*	*Katu*	*Esat-ushna*
20	*Sariva*	*Hemidesmus indicus*	*Asclepiadaceae*	*Madhura, Tikta*	*Guru, Snigdha*	*Madhura*	*Sheet*

21	*Chopchini*	*Smilax china*	*Liliaceae*	*Tikta*	*Laghu, Ruksha*	*Katu*	*Ushna*
22	*Dhamargav*	*Luffa cylindrica*	*Cucurbitaceae*	*Tikta*	*Laghu, Ruksha*	*Katu*	*Ushna*
23	*Aristaka*	*Sapindus trifoliatus*	*Sapindaceae*	*Tikta, Katu*	*Laghu, Tekshna*	*Katu*	*Ushna*
24	*Hijjal*	*Barringtonia acutangula*	*Lecythidaceae*	*Tikta, Katu*	*Laghu, Ruksha*	*Katu*	*Ushna*
25	*Krisnabeej*	*Ipomoea nil*	*Convolvulaceae*	*Katu, Madhura*	*Laghu, Ruksha*	*Katu*	*Ushna*
26	*Endravaruni*	*Cirullus colocynthis*	*Cucurbitaceae*	*Tikta*	*Laghu, Ruksha*	*Katu*	*Ushna*
27	*Peelu*	*Salvadora persica*	*Salvadoraceae*	*Tikta, Madhura*	*Laghu, Snigdha*	*Katu*	*Ushna*
28	*Dugdhpheni*	*Taraxacum officinale*	*Compositae*	*Tikta, Katu*	*Laghu, Ruksha*	*Katu*	*Ushna*
29	*Arjuna*	*Terminalia arjuna*	*Combretaceae*	*Kashaya*	*Laghu, Ruksha*	*Katu*	*Sheet*
30	*Brahmi*	*Centella asiatica*	*Umbelliferae*	*Tikta*	*Laghu*	*Madhura*	*Sheet*
31	*Devdali*	*Luffa echinata*	*Cucurbitaceae*	*Katu, Tikta*	*Laghu, Ruksha*	*Katu*	*Ushna*
32	*Aavartani*	*Helicteres isora*	*Sterculiaceae*	*Kashaya*	*Laghu, Ruksha*	*Katu*	*Sheet*
33	*Yavani*	*Trachyspermum ammi*	*Umbelliferae*	*Katu, Tikta*	*Laghu, Ruksha*	*Katu*	*Ushna*
34	*Engudi*	*Balanites aegyptiaca*	*Simaroubaceae*	*Tikta, Katu*	*Laghu, Snigdha*	*Katu*	*Ushna*
35	*Madhuka*	*Madhuca indica*	*Sapotaceae*	*Madhura, Kashaya*	*Guru, Snigdha*	*Madhura*	*Sheet*
36	*Mulethi*	*Glycyrrhiza glabra*	*Fabaceae*	*Madhura*	*Guru, Snigdha*	*Madhura*	*Sheet*
37	*Ashwabala*	*Medicago sativa*	*Fabaceae*	*Tikta*	*Guru*	*Katu*	*Ushna*
38	*Safed musali*	*Asparagus adscendens*	*Liliaceae*	*Madhura*	*Guru, Snigdha*	*Madhura*	*Sheet*
39	*Talmuli (Kali musali)*	*Curculigo orchioides*	*Amaryllidaceae*	*Madhura, Tikta*	*Guru, Snigdha, Pischil*	*Madhura*	*Ushna*
40	*Kebuka*	*Costus speciosus*	*Zingiberaceae*	*Tikta, Kashaya*	*Laghu, Ruksha*	*Katu*	*Sheet*
41	*Kampillak*	*Mallotus philippensis*	*Euphorbiaceae*	*Katu*	*Laghu, Ruksha, Tekshna*	*Katu*	*Ushna*
42	*Methika*	*Trigonella foenumgreacum*	*Umbelliferae*	*Katu*	*Laghu, Snigdha*	*Katu*	*Ushna*
43	*khatme*	*Althoea officinalis*	*Malvaceae*	*Madhura*	*Snidha, Pischil,Guru*	*Madhura*	*Sheet*
44	*Kalajaji*	*Nigella sativa*	*Ranunculaceae*	*Katu, Tikta*	*Laghu, Ruksha, Tekshna*	*Katu*	*Ushna*
45	*Apamarga*	*Achyranthes aspera*	*Amaranthaceae*	*Katu, Tikta*	*Laghu, Ruksha, Tekshna*	*Katu*	*Ushna*
46	*Kasheruka*	*Scirpus kysoor*	*Cyperaceae*	*Madhura, Kashaya*	*Guru, Ruksha*	*Madhura*	*Sheet*
47	*Karanja*	*Pongamia pinnata*	*Fabaceae*	*Tikata, Katu, Kashaya*	*Laghu, tekshna*	*Katu*	*Ushna*
48	*Matsyakshi*	*Alternanthera sessilis*	*Amaranthaceae*	*Tikta, Kashaya*	*Laghu*	*Katu*	*Sheet*
49	*Priyangu*	*Callicarpa macrophylla*	*Verbenaceae*	*Tikta, Kashaya, Madhura*	*Guru, Ruksha*	*Katu*	*Sheet*
50	*Adhaki*	*Cajanus cajan*	*Fabaceae*	*Kashaya, Madhura*	*Laghu, Ruksha*	*Madhura*	*Sheet*
51	*Bimbi*	*Coccinia indica*	*Cucurbitaceae*	*Tikta*	*Laghu, Ruksha, Tekshna*	*Katu*	*Ushna*
52	*Mudag*	*Phaseolus radiatus*	*Papilionaceae*	*Kashaya, Madhura*	*Laghu, Ruksha*	*Katu*	*Sheet*
53	*Udambar*	*Ficus racemosa/ F. glomerulata*	*Moraceae*	*Kashaya*	*Guru, Ruksha*	*Katu*	*Sheet*
54	*Sahadevi*	*Vernonia cineria*	*Compositae*	*Tikta*	*Laghu, Ruksha*	*Katu*	*Ushna*
55	*shakhotaka*	*Streblus asper*	*Moraceae*	*Tikta, Kashaya*	*Laghu, Ruksha*	*Katu*	*Ushna*
56	*Shalmali (Mochras)*	*Bombax ceiba*	*Bombacaceae*	*Kashaya*	*Snigdha, Pischil*	*Katu*	*Sheet*
57	*Ikshavaku*	*Lagenaria siceraria*	*Cucurbitaceae*	*Tikta*	*Laghu, Ruksha*	*Katu*	*Sheet*
58	*Chincha*	*Tamarindus indica*	*Caesalpiniaceae*	*Amala*	*Guru, Ruksha*	*Amala*	*Ushna*
59	*Kadali*	*Musa paradisica*	*Musaceae*	*Madhura*	*Guru, Snigdha*	*Madhura*	*Sheet*
60	*Patranga*	*Caesalpinia sappan*	*Fabaceae*	*Kashaya, Tikta, Madhura*	*Ruksha*	*Katu*	*Sheet*
61	*Priyaal*	*Buchanania lanzan*	*Anacardiaceae*	*Madhura*	*Snigdha, Guru, Sara*	*Madhura*	*Sheet*
62	*Varahikand*	*Dioscorea bulbifera*	*Dioscoreaceae*	*Katu, Tikta, Madhura*	*Laghu, Snigdha*	*Katu*	*Ushna*
63	*Kadar*	*Acacia suma*	*Fabaceae*	*Tikta, Kashaya*	*Laghu, Ruksha*	*Katu*	*Sheet*
64	*Kumbhi/ Katbhi*	*Careya arborea*	*Lecythidaceae*	*Katu*	*Ruksha, Ushna*	*Katu*	*Ushna*
65	*Latakaranj*	*Caesalpinia crista*	*Caesalpinioideae*	*Tikta, Kashaya*	*Laghu, Ruksha*	*Katu*	*Ushna*
66	*Chopchini*	*Smilax china*	*Liliaceae*	*Tikta*	*Laghu, Ruksha*	*Katu*	*Ushna*

Discussion & Conclusion

Saponins are consumed in many common foods and beverages including oats, spinach, asparagus, soya beans and other legumes, peanuts, tea and beer. Properties of saponin containing herbs are many & varied and may include alterative, diuretic, expectorant, anti-catarrhal, anti-inflammatory, antispasmodic, aphrodisiac, antioxidant, emmenagogue, cardiac stimulant, hormone modulating, hepatoprotective, adrenal adaptogenic effects and to act as a broad, frontline shield reduces the burden on the immune system [15]. Humans generally do not suffer severe poisoning from saponins**.** Our cholesterin inactivates them so that only our mucus membranes are affected. Some however are poisonous if swallowed and can cause urticaria (skin rash) in many people. Possibly their most important property is to accelerate the body's ability to absorb other active compounds. Saponins offer tremendous health benefits. Thus, plants containing saponins are becoming research focus all over the world.

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