Review

GENUS *FAGOPYRUM*: PHYTOCHEMICAL AND ETHNOPHARMACOLOGICAL REVIEW

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ABSTRACT:

Fagopyrum belong to family Polygonaceae. We have reviewed traditional uses, pharmacological potential and phytochemical study of genus Fagopyrum. Traditionally, most of the species are used for Anemia, constipation, hemorrhagic complaints, hypotensive patients, lumbago, dysentery, abdominal pain due to menstruation, postpartum pain due to blood stasis and pulmonary sepsis. Fagopyrum possess Antimicrobial activity, Anti- tumor effect, Anti-hypoglycemic activity, Anti-inflammatory, Analgesic activity and anti-oxidant activity. Phytochemical reports on genus Fagopyrum are flavanoids, steroids, organic acids and other miscellaneous compounds.

Keywords: Fagopyrum, Polygonaceae, Ethnomedicinal, Phytochemistry, hemorrhagic complaints, Ethnopharmacology, Ethnobotany.

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INTRODUCTION:

Majority of population in developing world is struggling to raise living standards and improvement of health care delivery due to increasing poverty and population. According to an estimate, 70-80% of rising world is dependent on conventional plants obtained remedies as pharmaceuticals are high priced. From this reality, it can be retrieved that by data assembling and experimentation, valuable plus economical medicaments can be separated from different flora to satisfy requirements of evolving world. Hence requirements of officinal plants cannot be neglected.

Ethnomedicinal importance of Fagopyrum:

Fagopyrum esculentum also known as Polygonum. Fagopyrum esculentum is commonly used in the community medicines. Leaves of F. esculentum are used to treat anemic patients. Poultice of leaves are also used to cure old constipation [1]

The aerial parts of Fagopyrum esculentum and its extract are used in traditional medicine and herbal remedies for the treatment of hemorrhagic complaints and for hypotensive patients.

Fagopyrum dibotrys is used to relieve internal heat and dispel toxins, to increase the circulation of blood and reduce blood stasis, to strengthen the function of spleen and treatment of fungus infection, and therapy of the cancer cell attacks. Fagopyrum dibotrys decoction of roots are also used to treat lumbago, dysentery, abdominal pain due to menstruation and postpartum pain due to blood stasis [2]

The Fagopyrum cymosum is used in pulmonary sepsis in folk medicine [3].

Table 1: Traditional uses of genus *Fagopyrum*

Species	Part use	Traditional uses
Fagopyrum esculentum	Leaves	Anemic patients, Poultice of leaves are also used to cure old constipation [1]
-----do-----	Aerial	Herbal remedies for the treatment of hemorrhagic complaints and for hypotensive patients [2]
Fagopyrum dibotrys	Roots	It is used to relieve internal heat and dispel toxins, to increase the circulation of blood and reduce blood stasis, to strengthen the function of spleen and treatment of fungus infection, therapy of the cancer cell attacks, lumbago, dysentery, abdominal pain due to menstruation and postpartum pain due to blood stasis[2]
Fagopyrum cymosum		The *Fagopyrum cymosum* is used in pulmonary sepsis in folk medicine[3].

Pharmacological reports on genus Fagopyrum:

Antibacterial activity:

Fagopyrum dibotrys belonging to family Polygonaceae shows significant antibacterial activity against Escherichia coli, Bacillus thuringiensis, Staphylococcus aureus, Bacillus subtilis, Diplococcus Catarrhalis, Sclerophthora macrospora, Pestalotia funereal, Sclerotinia sclerotiorum, urvularia lunata (walk) boed, and Gibberelle zeae (schw)[4]. Ethanol extract of Fagopyrum dibotrys demonstrated a wide spectrum of antibacterial activity [5]

Antimicrobial activity:

Ethanol/water (80/20 v/v) extract of Fagopyrum esculentum moench belonging to family Polygonaceae shows significant antimicrobial activity against gram-positive bacteria Bacillus cereus, Enterococcus faecalis, Staphylococcus aureus and also shows activity against gram-negative bacteria Salmonella choleraesuis, Proteus mirabillis and Escherichia coli. Antimicrobial activity is due to occurrence of flavonoids in buck wheat hulls [6]

Fagopyrum esculentum moench (buckwheat) showed antibacterial activity against Listeria monocytogenes. Agar broth dilution method was used to determine antibacterial activity. Fagopyrum esculentum moench (buckwheat) shows wide range of antibacterial activities ranging from MICs of 62.5 to 500 µg/ml and shows relative high levels of antibacterial activity at MIC 62.5 µg/ml against Listeria monocytogenes [7].

Anti-hyperglycemic activity:

Ethanol extracts of Fagopyrum tataricum possess anti-hyperglycemic and anti-insulin resistance effects. The experiment was conducted on animals after fasting for 12 hr. given free access to water. Animals were given glucose (2g/kg of body weight). From the tail vain of animals blood samples were collected at intervals of 0, 30, 60, 90, and 120min after glucose administration. The experiment reveals that 75% ethanol extract of Fagopyrum tataricum possess anti-hyperglycemic activity [8].

Anti- Cancer effect:

Extract of *Fagopyrum dibotrys* shows extraordinary inhibitory results against tumor invasion and metastasis[9]. Fagopyrum cymosum is responsible for inhibition of tumor cell growth by manipulating the metabolism of Deoxyribo nucleic acid in low concentrations and plays the major role [10]

Fagopyrum cymosum found affective in inhibition of the growth of the malignant cells of lungs, colon, liver leukocytes and bones but do not show activity against prostrate, ovary, cervix and brain cancerous cells. Cancer cells from breast (MCF-7) are stimulated by the Fagopyrum cymosum extract. Daunomycin and Fagopyrum cymosum Shows synergistic inhibition in human lung cancer cells (H460). Fagopyrum cymosum treated cellular protein from H460 was analyzed by 2D-gel electrophoresis shows the induced protein [11]. Effects of Tatariside G (TG) Isolated from *Fagopyrum tataricum* Roots on Apoptosis in Human Cervical Cancer HeLa Cells was studied and was found that TG notably inhibited cell viability, enhanced the percentage of apoptotic cells, facilitated the phosphorylation of p38 MAPK and JNK proteins and caspase-3 and caspase-9 cracking, downregulated the phosphorylation level of Akt, and increased the loss of MMP and the mRNA expression of caspase-3 and caspase-9. TG-induced apoptosis is associated with activation of the mitochondrial death

pathway. TG may be an effective candidate for chemotherapy against cervical cancer [21].

Anti-inflammatory:

Extract of Fagopyrum dibotrys on animal models exhibited topical anti-inflammatory activity on chronic inflammation [12]. Additionally, the extract decrease the mortality of mice's and the twisting of body produced by diethylstilbestrol and oxytocin. It also have significant role in the reduction of tension of isolated mouse uterus stimulated by oxytocin [13].

Fagopyrum esculentum moench (common buckwheat) sprouts may be a useful material for treatment or prevention of the progress of inflammatory diseases as it showed significant anti-inflammatory activity in vitro and in vivo. Extract of *Fagopyrum esculentum moench* (common buckwheat) shows significant both in vitro and in vivo anti-inflammatory activity [20].

Antioxidant activity:

The antioxidant effect of ethanol extract of *Fagopyrum tataricum* on the DPPH radical scavenging activity was measured. Different concentrations (0.3-10mg/ml) of ascorbic acid and ethanol extract of Fagopyrum tataricum were made and mixed with 4 ml of each of ascorbic acid and ethanol extract of Fagopyrum tataricum with 1mM DPPH methanol solution. The solution having no DPPH methanol solution act as a blank. Allow the solutions to stand at room temperature for 30 minutes and the analyzed the solution spectro-photometrically at wavelength of 517 nm. Lower the absorbance higher will be the anti-oxidant activity. The ethanol extract of Fagopyrum tataricum shows antioxidant activity [14].

Fagopyrum esculentum moench (buckwheat) hull, seeds, sprouts, leafs and flowers extracts are effective for protecting biological systems against various oxidative stresses in vitro, and to have antioxidant activity in vivo [19].

Miscelleous Activities:

Effect of *Fagopyrum cymosum (Trev.) Meisn* alcohol extract (FAE) on defecation and isolated colon of diarrhea-IBS rats and its mechanism were studied. Effective components of FAE improved the defecation function and inhibited enterospasm induced intestinal hyperactivity in IBS model rats via antagonizing calcium channel competitively and inhibiting colonic motility dose-dependently [22].

Phytochemical reports on genus Fagopyrum

Flavonoids:

Rutin was the first compound isolated from *Fagopyrum dibotrys*[15]. From this plant more than 80 phytoconstituents have been identified and isolated. From the root extract of *Fagopyrum dibotrys* new flavonoids have been identified which were named by trivial methods e.g. Quercetin **(1)**, Isorhamnetin **(2)**, luteolin **(3)**, pratol **(4)**, luteolin-7, 4′-dime-thylether **(5)**, rhamnetin **(6)**, 3, 6, 3′, 4′-tetrahydroxy-7-methoxyflavon **(7)**, hesperidi **(8).** In *Fagopyrum esculentum* the important component is a flavonol glycoside quercetin-3-rhamnoglucoside (rutin). Rutin content were reported to present in the processed groats, flowers and leaves of buckwheat. Rutin **(9)** Hyperoside **(10)** orientin **(11)** isovitexin **(12)** vitexin **(13)** and isoorientin **(14)** found in *Fagopyrum esculentum* hulls [23-25]

In *Fagopyrum cymosum* component A the dimer of 5, 7, 3', 4'-tetrahydroxyflavan-3-ol (C4-C8 linked),

named as dimeric procyanidin **(15)** have been structurally identified. The component A is an important component and have therapeutic effects. Separation of five flavonoids from tartary buckwheat (*Fagopyrum tataricum* (L.) Gaertn) grains via off-line two dimensional high-speed counter-current chromatography were studied. n-Hexane–ethyl acetate–methanol–water 3:5:3:5 (v/v) was selected as the first dimension solvent system to purify quercetin **(1)** and kaempferol. The second dimension solvent system, ethyl acetate–n-butanol–water 7:3:10 (v/v), was used to isolate quercetin 3-O-rutinoside-3′-O-β-glucopyranoside, rutin and kaempferol 3-rutinoside [26].

Steroids:

From the root of Fagopyrum dibotrys steroids have been isolated [3]. For example shecogenin **(16),** β-sitosterol **(17)** and β-daucosterol **(18)** also isolated.

Organic acids:

The important component of the Fagopyrum dibotrys plant are organic acids e.g. protocatechuic acid, **(19)** protocatechuic acid methyl ester **(20)** p-hydroxy-benzoic acid **(21)** Benzoic acid **(22)** syringic acid **(23)** succinic acid **(24).** These components have been isolated from Fagopyrum dibotrys. In Fagopyrum esculentum p-cumaric **(25),** Protocatechuic acid **(26)** ferulic acid **(27)** are found in lesser quantity in all plant parts.

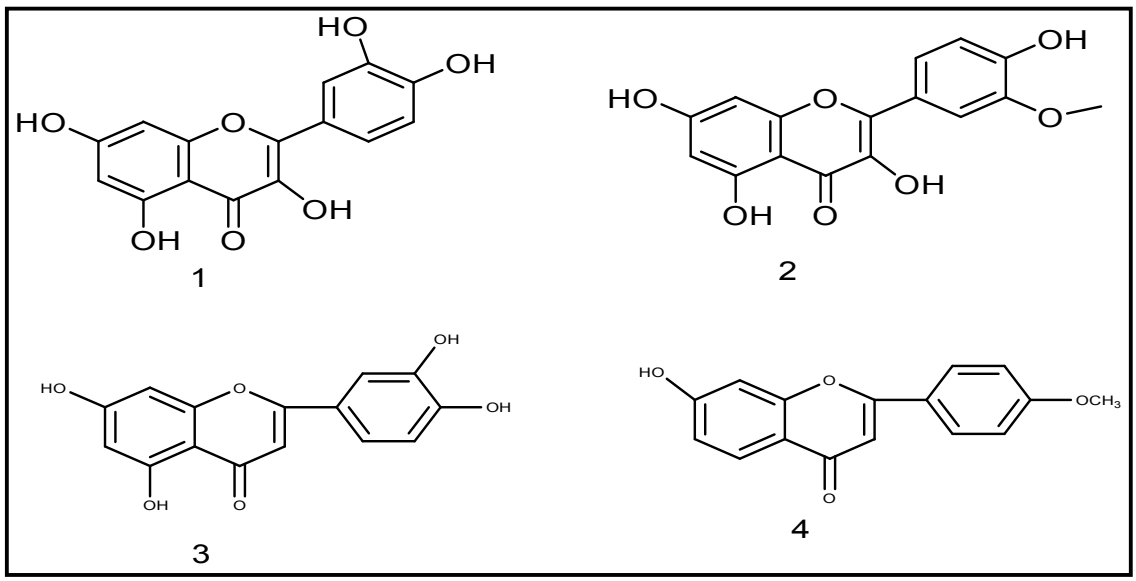
From Fagopyrum cymosum trans-p-hydroxy cinnamic methyl ester **(28)** protocatechuic acid **(29)** protocatechuic acid methyl ester 3, 4-dihydroxy benzamide **(30)** phenolic acid derivatives have been isolated.

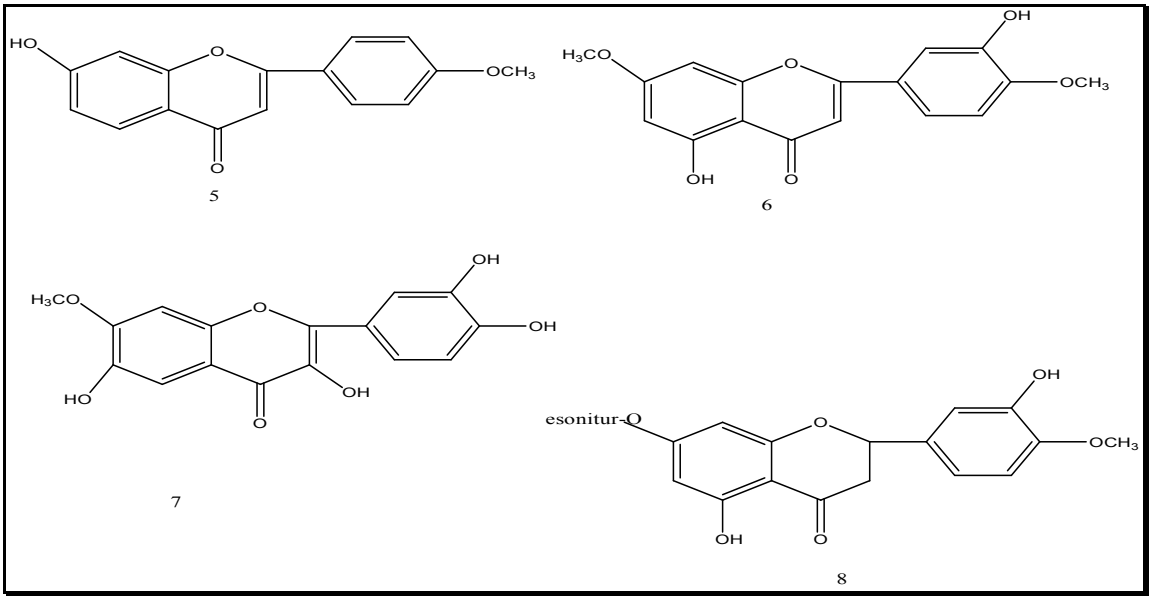
In Fagopyrum dibotrys, gallic acid, (31) (-)-epicatechin **(32)** (-)-epicatechin-3-O-gallate acid ester **(33)** 3, 4-dihydroxybenzoic acid **(34)** procyanidin C-1 **(35)** and procyanidin B-2 **(36)** from the alcoholic extract of the plant were isolated [16].

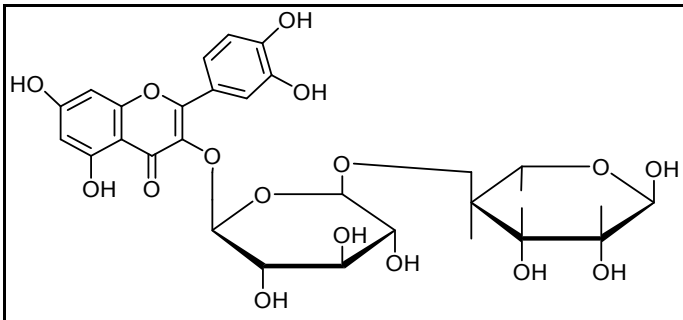
Miscellaneous compounds:

Wang et al. in 2005 isolated lapathoside A, **(37)** from the roots of Fagopyrum dibotrys. Glutinol, **(38)** was isolated by [17] and glutinone, **(39)** [17] [18]. Eriodictyol **(40)** 3, 5-dimethoxy benzene carbonic acid-4-O-glucoside **(41)** n-butyl-β-D-fructopy-ronoside **(42)** are also isolated from Fagopyrum dibotrys. Glycerol mono palmitate **(43)** n-trans-coumaroyl tyramine **(44)** emodin [9] **(45)** and shakuchirin [19] **(46)** have also been isolated from Fagopyrum-dibotrys.

Figure 1: Structure of compounds present in genus Fagopyrum







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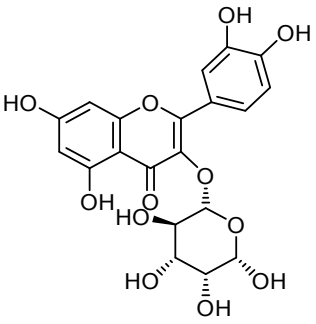

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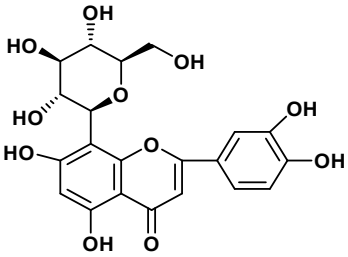

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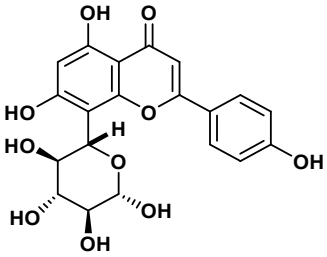

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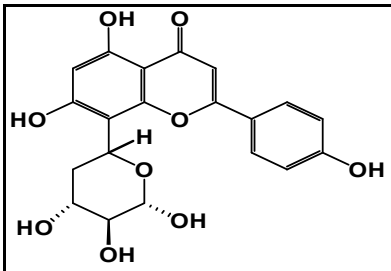

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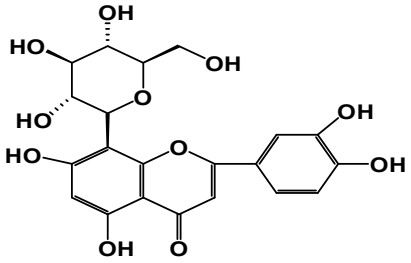

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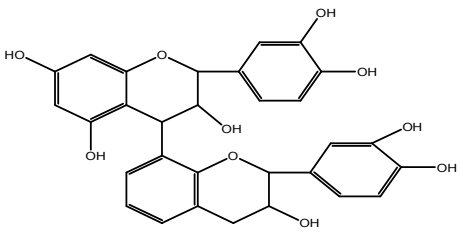

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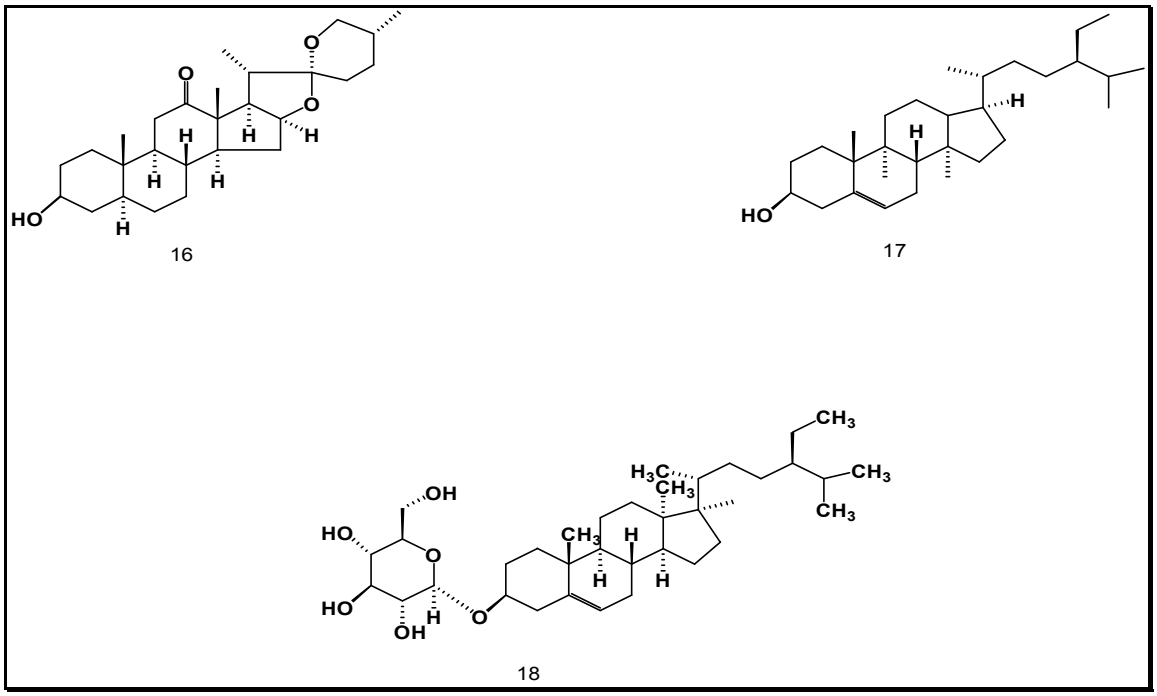
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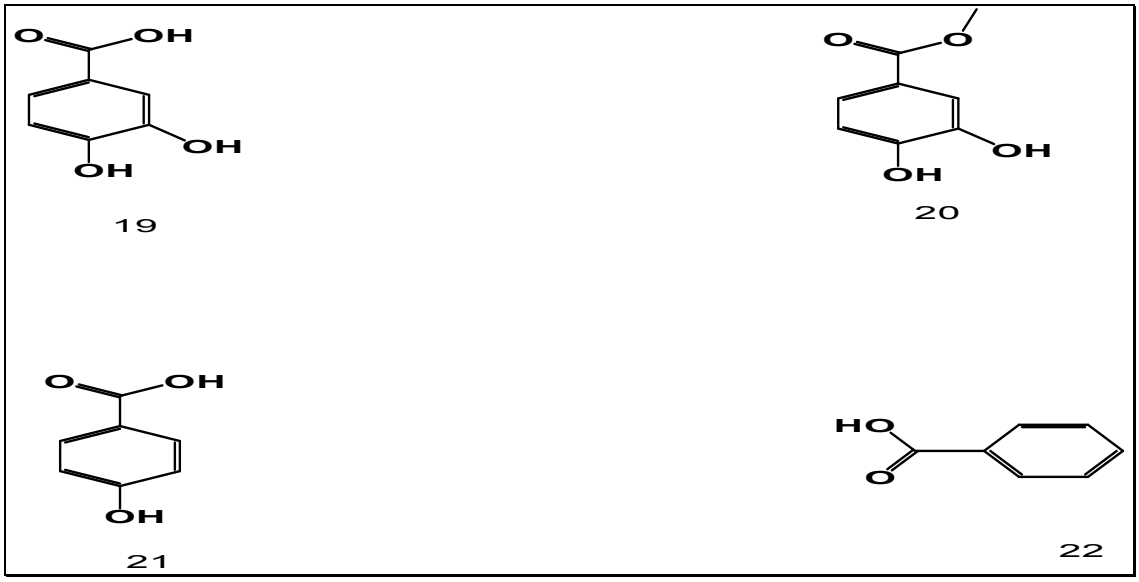
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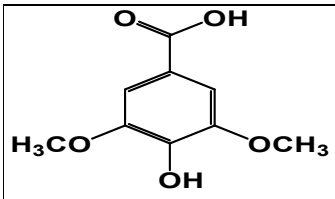

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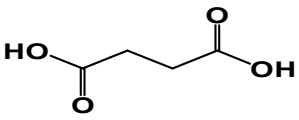

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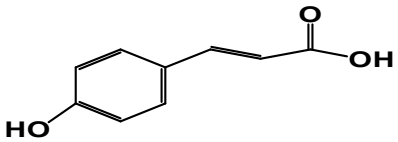

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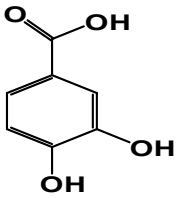

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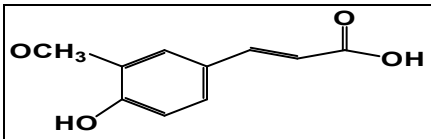

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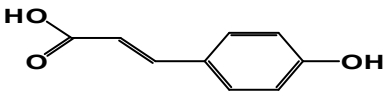

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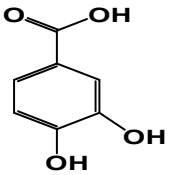

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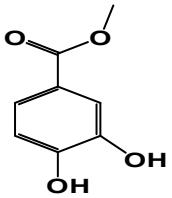

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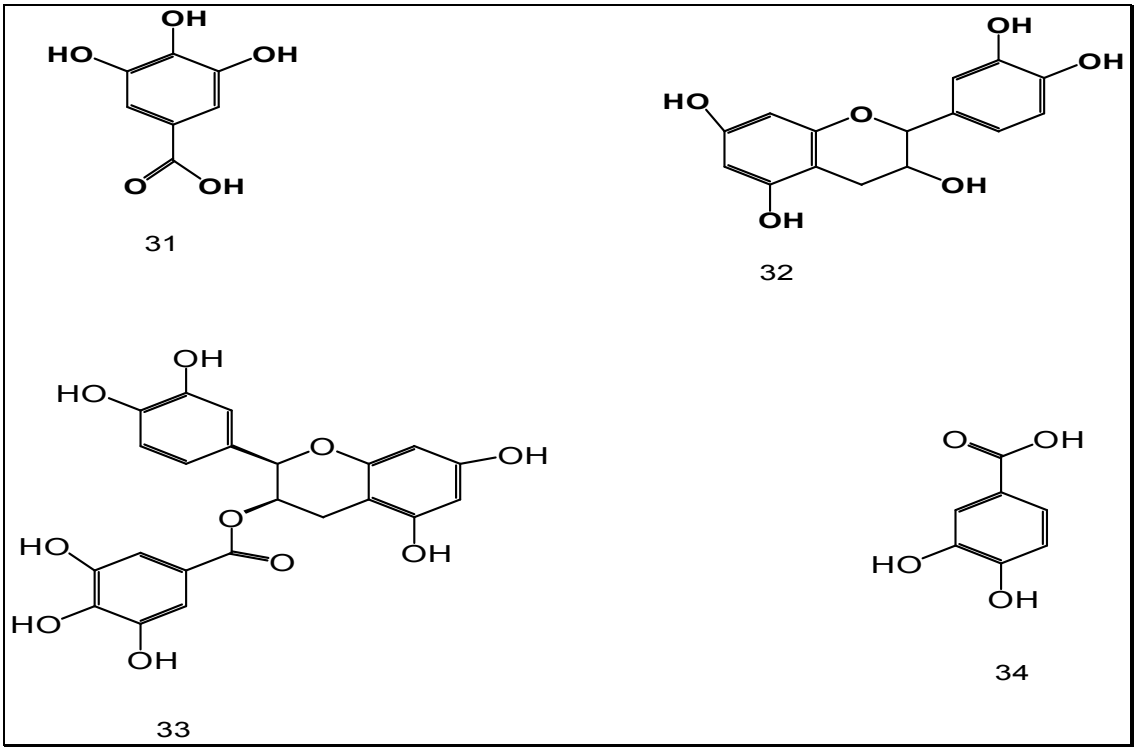
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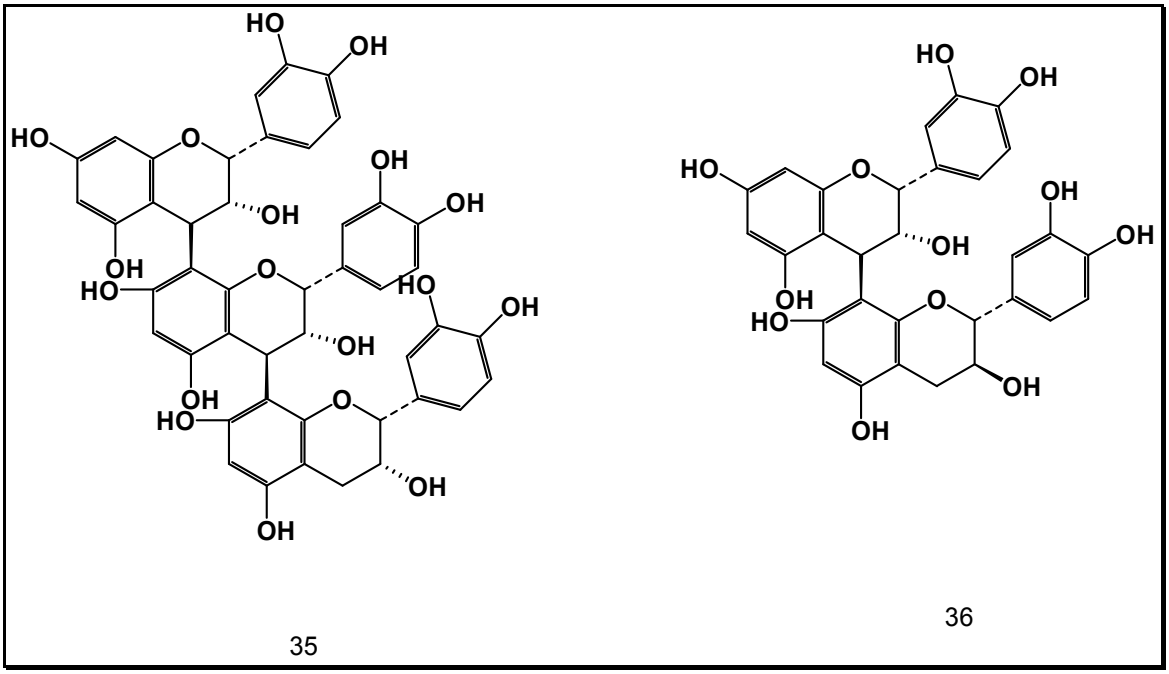
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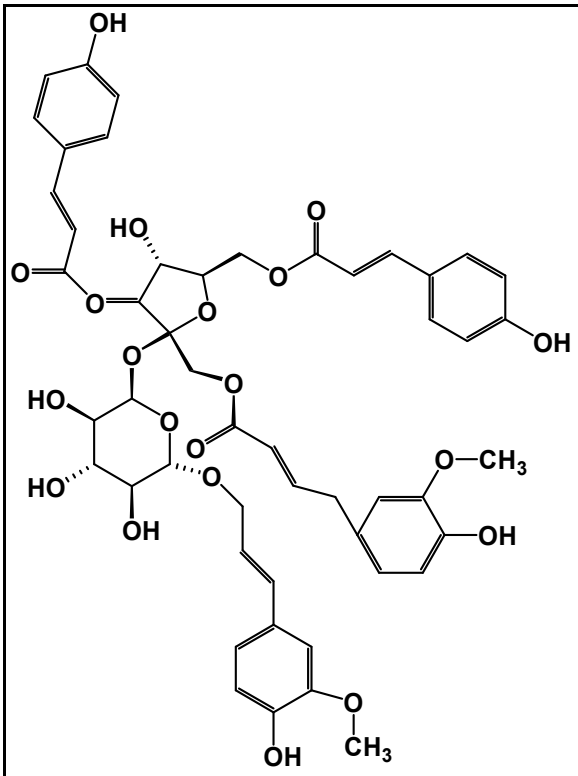

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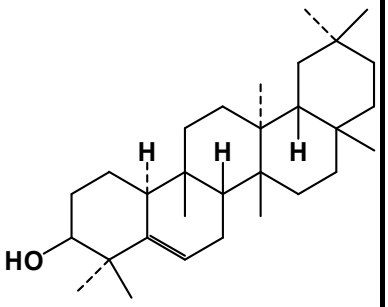

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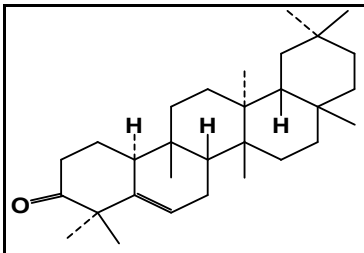

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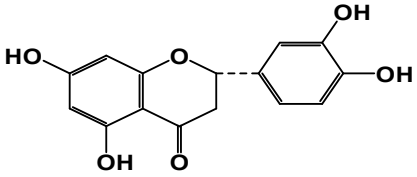

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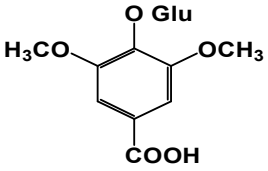

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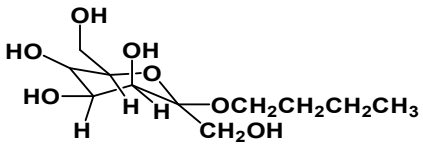

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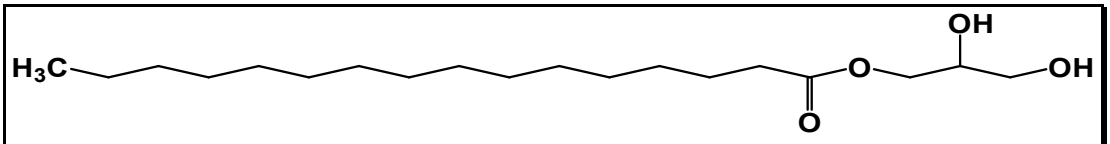
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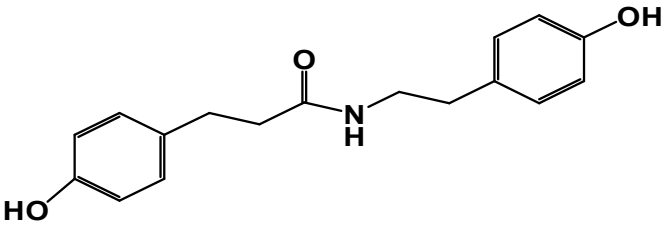
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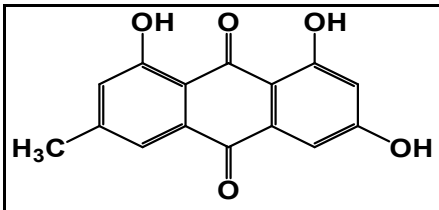
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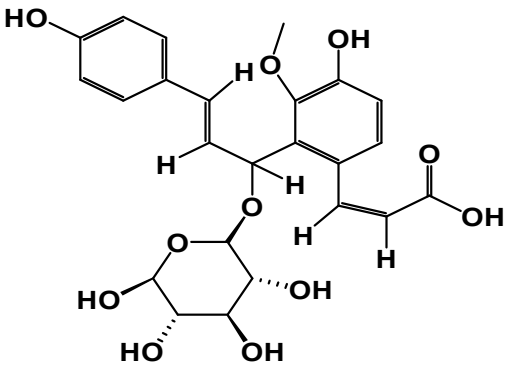
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REFERENCES:

1. Pant S, Samant SS, Arya SC., Diversity and indigenous household remedies of the inhabitants surrounding Mornaula reserve forest in west Himalaya., Indian Journal of Traditional Knowledge., 2009; 8 (4): 606- 610.

2. Rong M, Gang Z, Yu, T., Nutritional and medicinal values of Fagopyrum dibortrys., Journal of science international school of Bangkok., 2001; 8: 537-539.

3. Yong-long L, Fang Q, Zhang Z, Feng X, Zhang LF, Xue-wen He., Studies on the chemical constituents of Fagopyrum cymosum (Trev.) Meisn [J]., Acta Pharmaceutica Sinica 7., 1983; 012.

4. Feng LS, Chen F, Bai J. Study of antimicrobial in vitro from Fagopyrum dibotrys extracts., Journal of wuhan botanical research., 2006; 3: 240- 244.

5. Ai Q, Wang B, Wang GQ., Study on bacterio stasis of Fagopyrum cymosum Meisn preparation., Heilongjiang medicine journal., 2002; 9: 666.

6. Quettier-Deleu, Christel, Bernard Gressier, Jacques Vasseur, Thierry Dine, Claude Brunet, Michel Luyckx, Micheline Cazin, Jean-Claude Cazin, François Bailleul, Francis Trotin., Phenolic compounds and antioxidant activities of buckwheat (Fagopyrum esculentum Moench) hulls and flour., Journal of ethnopharmacology 2000; 72, no. 1: 35-42.

7. Cabarkapa IS, Sedej IJ, Sakac MB, Saric IC, Plavsic DV.,Antimicrobial activity of buckwheat (Fagopyrum esculentum moench) hulls extract., Food and feed research., 2008; 35: 159-164.

8. Chia-Chen L, Hsu WH, Shen SR, Cheng YH, Wu S., Fagopyrum tataricum (buckwheat) improved high-glucose-induced insulin resistance in mouse hepatocytes and diabetes in fructose-rich diet-induced mice., Experimental diabetes research., 2012.

9. Liu HY, Han R., Extract of Fagopyrum cymosum meissn inhibits tumor cell invasion and metastasis and suppresses type IV collagenase production of HT-1080 cells., Chemical and pharmaceutical bulletin., 1998; 1: 36-39.

10. Ma YP., [Interaction of component (E) with tumor cellular DNA]., Zhonghua zhong liu za zhi [Chinese journal of oncology]., 1989; 11(2): 95-97.

11. Chan P., Inhibition of tumor growth in vitro by the extract of Fagopyrum cymosum (fago-c). Life sciences., 2003; 72: 1851–1858.

12. Cheng YB, Pan HL., Study on the anti-inflammatory active site of rhizoma Fagopyrum dibotrys. Lishizhen medicine and materia medica research., 2009; 9: 2219-2220.

13. Jia W, Lu JM, Li XH, Li CY., Effects of rhizoma Fagopyrum dibotrys extraction on dysmenorrhea models in mouse. Liaoning university of traditional chinese medicine., 2010; 2: 198-199.

14. Danihelova M, Jantova S, Sturdik E., Cytotoxic and antioxidant activity of buckwheat hull. Journal of microbiology, biotechnology food sciences., 2013; 2: 1314-1323.

15. Imai, K, Furuya K., Phytochemical component of Fagopyrum cymosum. Journal of the pharmaceutical society of japan, 1951; 71: 263-266.

16. Zhang WJ, Li XC, Liu YQ, Yao RC, Nonaka GI, Yang CR., Phenolic constituents from Fagopyrum dibotrys. Acta botanica yunnanica., 1994; 4: 354-356.

17. Shao M, Yang YH, Gao HY, Wu B, Wang LB, Wu LJ., Phenolic acid derivatives from the rhizome

of Fagopyrum cymosum. Chinese journal of chinese materia medica., 2005; 20: 1591-1593.

18. Zhao LQ, Zhang XP, Zhang CF., Isolation and identification of chemical constituents of Fagopyrum dibotrys. Journal of food science., 2011; 19: 4-6.

19. Mukoda T, Sun B, Ishiguro A., Antioxidant activities of buckwheat hull extract towards various oxidative stress in vitro and in vivo. Biological and Pharmaceutical Bullentin., 2001; 24 (3): 209-13.

20. Ishii S, Katsumura T, Shiozuka C, Ooyauchi K, Kawasaki K, Takigawa S, Fukushima T, Tokuji Y, Kinoshita M, Ohnishi M, Kawahara M, Ohba K., Anti-Inflammatory effect of buckwheat sprouts in lipopolysaccharideactivatedhuman colon cancer cells and mice. Bioscience Biotechnology Biochemistry., 2008; 72 (12): 3148-3157.

21. Li Yuan, et al. Effects of Tatariside G Isolated from Fagopyrum tataricum Roots on Apoptosis in Human Cervical Cancer HeLa Cells. Molecules 19.8., 2014: 11145-11159.

22. Liu LN, Yan J, Sun ZG., [Effect of Fagopyrum cymosum (Trev.) Meisn alcohol extract on defecation and isolated colon of diarrhea-IBS rats and its mechanism]. Zhongguo Zhong xi yi jie he za zhi Zhongguo Zhongxiyi jiehe zazhi= Chinese journal of integrated traditional and Western medicine/Zhongguo Zhong xi yi jie he xue hui, Zhongguo Zhong yi yan jiu yuan zhu ban 2014; 34(12): 1469-1475.

23. Tian L, Xu LiZ, Yang SL., Studies on chemical composition of Fagopyrum cymosum (Trev.) Meisn. Chin. J. Chin. Mater. Med 1997; 12: 743-745.

24. Wang KJ, Zhang YJ, Yang CR. Antioxidant phenolic constituents from Fagopyrum dibotrys. J. Ethnopharmocol., 2005; 2: 259-264.

25. Wu HZ, Zhou JY, Pan HL. Study on chemical constituents of Fagopyrum dibotrys (D.Don) Hara. Chin. Hosp. Pharm. J., 2008; 21:1829-1831.

26. Jiang S, Liu Q, Xie Y, Zeng H, Zhang L, Jiang X, Chen X., Separation of five flavonoids from tartary buckwheat (Fagopyrum tataricum (L.) Gaertn) grains via off-line two dimensional high-speed counter-current chromatography. Food Chemistry. 2014.

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