Soybean isoflavones: Remedial nutraceuticals in Indian perspective

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Soybeans flour is a rich source of isoflavones, which are a subclass of ubiquitous flavonoids. Isoflavones, which have potent antioxidant properties comparable to that of vitamin E, can reduce the long-term risk of cancer by preventing free radical damage to DNA. Genistein followed by daidzein is the most predominant antioxidant among soybean isoflavones. This review describes extraction, purification and health care properties of soy isoflavones.

Keywords: Antioxidant, HPLC, Isoflavones, Soybeans

Introduction

Soybeans have been a favorite food in Asian countries and some other parts of the world for more than 5,000 years. Even, the people living in ancient China were growing soybeans in 2800 BC. In India, Madhya Pradesh, followed by Maharashtra, Rajasthan and Andhra Pradesh is the major producer of soybeans. During 2004-05, total soybean production in Madhya Pradesh was 44.439 tons (62% of the total), whereas the total produce from India was 72.083 tons.

Isoflavones

Soybean (main varieties: Braig, Ankur, Gaurav, Jawahar and Panjab-1) contains isoflavones, which are heterocyclic phenols that structurally closely relate to estrogenic steroids of animals, called phytoestrogens, which activate mammalian estrogen receptors and also they are like a substitution of vitamin E. Phytoestrogens are circulated in plasma primarily in the conjugated form (< 3% circulate in free form), mostly bound to glucoronic acid. Hydroxylation of the B-ring of isoflavones is an important factor for the antioxidative activity. Genistein and daidzein are the most predominant antioxidants among soybean isoflavones (Fig. 1).

Isoflavones in plant are mostly in the form of glycosides (Fig. 2), which are conjugated with glucose, biologically inactive, and not absorbed through the intestinal wall until or unless fermented. Soy isoflavones reduce serum testosterone and improve markers of oxidative stress. These compounds mainly possess anti-inflammatory, antiallergic, antiviral, anticarcinogenic, antineoplastic, antimicrobial, antihemminthic, liver protective, antithrombotic, antioxidant, metal chelation and antihormonal effects. Stabilization of vitamin C and its increased absorption is also noticed. Isoflavones also affect enzyme systems such as protein kinase C, tyrosine kinases, ornithine decarboxylase; nucleotide phosphodiesterases, lipoxygenases and glutathione S transferase. These enzymes play a role in the pathogenesis of diseases such as cancer, arthritis, heart disease, inflammatory diseases and in antimicrobial activity.

Kenneth Setchell first identified the isoflavones in the urine of laboratory animals.

Forms and Sources of Isoflavones

Except soy sauce and soy oil, basic sources of isoflavones are soybeans, soy nuts, tofu, tempeh, whole soymilk, soy powders or capsules. Raw soybeans contain isoflavones (2-4 mg/g, dry wt), which vary (0.5-2.0 mg) in soy protein. Isoflavones are both with and without a sugar molecule attached. There are 12 different soybean isoflavone isomers (Fig. 2).

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Fig. 1—Genistein and daidzein
Nutrient Content of Soybeans

Isoflavones are known antioxidants and genistein influences signal transduction through its effect on several enzymes. Soy foods typically contain more genistein than daidzein, although this ratio varies among different soy products (Table 1). Soy foods are good source of protein (Table 2) and minerals (Table 3).

Methods of Extraction and Purification of Isoflavones from Soybeans

Supercritical fluid extraction (SFE) method offers advantages over conventional methods such as increased selectivity, expeditiousness, automaticity, environmental safety, dramatically decreased use of organic solvents, higher speed and better reproducibility. HPCL method is suitable for extracting all the 12 forms of isoflavones. All the methods are as follows.

Superheated Water Extraction (SWE) Method

SWE is a viable alternative means of extracting five important isoflavones from defatted soybean flakes (DSF). For SWE, optimum conditions are: temperature, 110°C; and pressure, 641 psig (4520 kPa) over 2.3 h of extraction. Under optimum conditions, 3937 total isoflavones (TIF) µg/g DSF was produced. It was an efficient way of recovering and purifying the resulting samples by using solid-phase Amberlite XAD16-HP resin adsorption.

Table 1—Total isoflavone, genistein and daidzein content of selected foods

<table>
<thead>
<tr>
<th>Food</th>
<th>Serving</th>
<th>Genistein</th>
<th>Daidzein</th>
<th>Total isoflavones</th>
</tr>
</thead>
<tbody>
<tr>
<td>Soy protein concentrate, aqueous washed</td>
<td>100</td>
<td>56</td>
<td>43</td>
<td>102</td>
</tr>
<tr>
<td>Soy protein concentrate, alcohol washed</td>
<td>100</td>
<td>5</td>
<td>7</td>
<td>12</td>
</tr>
<tr>
<td>Miso</td>
<td>138</td>
<td>34</td>
<td>22</td>
<td>59</td>
</tr>
<tr>
<td>Soybeans, boiled</td>
<td>86</td>
<td>24</td>
<td>23</td>
<td>47</td>
</tr>
<tr>
<td>Tempeh</td>
<td>85.5</td>
<td>21</td>
<td>15</td>
<td>37</td>
</tr>
<tr>
<td>Soybeans, dry roasted</td>
<td>28.5</td>
<td>19</td>
<td>15</td>
<td>37</td>
</tr>
<tr>
<td>Soy milk</td>
<td>275</td>
<td>17</td>
<td>12</td>
<td>30</td>
</tr>
<tr>
<td>Tofu yogurt</td>
<td>131</td>
<td>12</td>
<td>7</td>
<td>21</td>
</tr>
<tr>
<td>Tofu</td>
<td>85.5</td>
<td>12</td>
<td>8</td>
<td>20</td>
</tr>
</tbody>
</table>

Table 2—Total protein, carbohydrate, fat and saturated fat content of selected foods

<table>
<thead>
<tr>
<th>Food</th>
<th>Calories</th>
<th>Protein</th>
<th>Carbohydrate</th>
<th>Fat</th>
<th>Saturated fat</th>
</tr>
</thead>
<tbody>
<tr>
<td>Soybeans, cooked</td>
<td>165</td>
<td>15.7</td>
<td>14.1</td>
<td>6.4</td>
<td>1.1</td>
</tr>
<tr>
<td>Tempera</td>
<td>59</td>
<td>11</td>
<td>7</td>
<td>0.2</td>
<td>Fat free</td>
</tr>
<tr>
<td>Soy nuts</td>
<td>404</td>
<td>30</td>
<td>29</td>
<td>20.3</td>
<td>3.2</td>
</tr>
<tr>
<td>Tofu</td>
<td>94</td>
<td>10</td>
<td>2.3</td>
<td>5.9</td>
<td>0.9</td>
</tr>
<tr>
<td>Soy flour, defatted</td>
<td>163.4</td>
<td>25.6</td>
<td>16.8</td>
<td>0.6</td>
<td>.04</td>
</tr>
<tr>
<td>Soy milk, plain</td>
<td>39.5</td>
<td>3.3</td>
<td>2.15</td>
<td>2.3</td>
<td>0.25</td>
</tr>
</tbody>
</table>
resulting fine powder was stored at -32°C. The extract was centrifuged for 10 min, using a Backman CS-6 centrifuge. The precipitates from first extractions were subjected through a 0.45 µm filter unit prior to HPLC analysis.

Table 3—Mineral content of soybeans

<table>
<thead>
<tr>
<th>Food</th>
<th>Niacin mg</th>
<th>B6 mg</th>
<th>Folic acid mg</th>
<th>Calcium mg</th>
<th>Iron mg</th>
<th>Magnesium mg</th>
<th>Copper mg</th>
<th>Zinc mg</th>
</tr>
</thead>
<tbody>
<tr>
<td>Soybeans cooked, 1/2 cup</td>
<td>1.35</td>
<td>0.20</td>
<td>47</td>
<td>88</td>
<td>4.42</td>
<td>74</td>
<td>0.35</td>
<td>0.99</td>
</tr>
<tr>
<td>Tempeh, 1/2 cup</td>
<td>3.8</td>
<td>0.25</td>
<td>43</td>
<td>77</td>
<td>1.9</td>
<td>58</td>
<td>.55</td>
<td>1.5</td>
</tr>
<tr>
<td>Textured cooked soy protein, 1/2 cup</td>
<td>.75</td>
<td>0.12</td>
<td>-</td>
<td>85</td>
<td>2</td>
<td>86</td>
<td>0.32</td>
<td>1.37</td>
</tr>
<tr>
<td>Soynuts, 1/2 cup</td>
<td>1.2</td>
<td>0.18</td>
<td>182</td>
<td>118</td>
<td>2.3</td>
<td>126</td>
<td>0.7</td>
<td>2.7</td>
</tr>
<tr>
<td>Tofu, 1/2 cup</td>
<td>0.2</td>
<td>0.06</td>
<td>19</td>
<td>130*</td>
<td>-</td>
<td>127</td>
<td>0.24</td>
<td>1.00</td>
</tr>
<tr>
<td>Soyflour defatted, 1/2 cup</td>
<td>130</td>
<td>0.28</td>
<td>156</td>
<td>120</td>
<td>4.6</td>
<td>144</td>
<td>2</td>
<td>1.22</td>
</tr>
<tr>
<td>Soy milk plain, 1/2 cup</td>
<td>0.7</td>
<td>0.05</td>
<td>2</td>
<td>5</td>
<td>0.69</td>
<td>22.5</td>
<td>0.144</td>
<td>0.27</td>
</tr>
<tr>
<td>Miso, 2 Tbsp</td>
<td>0.3</td>
<td>-</td>
<td>10.1</td>
<td>23</td>
<td>0.95</td>
<td>14.5</td>
<td>0.15</td>
<td>1.0</td>
</tr>
<tr>
<td>Adult recommended daily allowance</td>
<td>15</td>
<td>1.6</td>
<td>180-200</td>
<td>800</td>
<td>10-15</td>
<td>280-350</td>
<td>1.5-3.0</td>
<td>12-15</td>
</tr>
</tbody>
</table>

Ultrasound-assisted Extraction (UAE) Method

Efficiency in extracting four isoflavone derivatives (daidzin, glycitin, genistin and malonyl genistin) from freeze-dried ground soybeans using UAE is more comparing than other methods, particularly mix-stirring extraction. UAE improved extraction efficiency of soy isoflavones but this method was dependent on the solvent employed, ratios of sample quantity to solvent volume and length of extraction time. Isoflavones can be quantitatively extracted from soybeans with 50% ethanol at 60°C using UAE in 20 min.

Pressurized Liquid Extraction (PLE) Method

Several researchers have successfully used PLE to extract chemically similar natural products from different matrices, like phenolic compounds from grape seeds and apple and proanthocyanidins from malt. Under PLE conditions, degradation of malonyl glucoside forms of the isoflavones takes place if temperature is higher than 100°C whereas degradation of glucosides takes place above 150°C. So using the optimized protocol (sample, 0.1 g; temp, 100°C; three static extraction cycles, 7 min; and ethanol 70% as extracting solvent), isoflavones can be extracted from freeze-dried soy matter.

Solid-phase Extraction (SPE) Method

SPE method basically is used to evaluate the accuracy of isoflavones from soybeans. It can be obtained by solid–liquid extraction of ground soybeans on an ultrasonic bath of 360 W. Analytical protocol was scaled up to obtain a large amount of extract and consists of extracting approx 10 g of ground soybeans in 250 ml of 50% ethanol for 30 min at 60°C. The extract was centrifuged for 10 min, filtered through filter paper and freeze-dried. The resulting fine powder was stored at -32°C. The standardized extract used throughout the development of SPE method consists of 0.1 g of this freeze-dried extract dissolved in 25 ml of water.

Supercritical Fluid Extraction (SFE) Method

Under SFE, CO2 is most commonly used as solvent. The comparative study of supercritical carbon dioxide (SC-CO2), with conventional extraction methods (soxhlet and ultra-sonification), revealed that extraction of genistin and genistein at 70°C/200 bar using a mixture of CO2 (55.2 g) and modifier (10 mol%), resulted in lower values than conventional methods. Analytical results additionally showed a predominant effect of temperature in the amount of genistin and genistein extracted by SC-CO2. Extraction of daidzein at 50°C/360 bar resulted in higher values than conventional methods and a predominant effect of the pressure was observed. Maximum amount of total isoflavonoids extracted by each methods was: ultra-sonification, 311.55; soxhlet, 212.86; and SC-CO2, 86.28 µg·g⁻¹.

Soy protein isolate-ProFam 873 (SPI) Method

Using SPI method, nine different isoflavones (daidzin, glycitein, genistein, daidzin, glycitin, genistin, malonyl-daidzin, malonyl-glycitin and malonyl-genistin) were isolated using three different solvents [80% acetonitrile–HCl, 0.1 N methanol (80%) and 80% ethanol]. Samples (2 g) were dispersed in each solvent (10 ml) and vigorously mixed at room temperature for 2 h using a VWR-Rocking Platform Shaker (Model 200). The dispersions were then centrifuged for 30 min at 3000 rpm, using a Beckman CS-6 centrifuge. The extracts were taken to dryness under a flow of nitrogen, re-dissolved in 80% methanol and filtered through a 0.45 µm filter unit prior to HPLC analysis. The precipitates from first extractions were subjected to acid hydrolysis to form their glucosidal forms.
to repeated extractions (total of 5 extractions), with each extraction lasting 2 h. A second set of samples, dispersed in the same solvents, was subjected to sonication in a VWR-Aquasonic (Model 750D) at ultrasonic frequency of 50-60 Hz. Samples were maintained at 22°C (with a thermostatic controller) and sonicated for 15, 30 and 60 min. All extracts were then centrifuged for 30 min at 3000 rpm, dried with nitrogen, re-dissolved in 80% methanol and filtered prior to HPLC analysis.

**HPLC Analysis Method**

Simplified HPCL method is comparatively better than other conventional methods for separating isoflavones (Table 4).

**Physiological Importance of Soybean Isoflavones**

Soybean isoflavones show about 1/1,000 to 1/100,000 the activity of estradiol. Isoflavones as wonder neutraceuticals are fueled by three important therapeutic effects: i) Estrogenic; ii) anticarcinogenic; and iii) anticholesterolemic. Following are specific:

**Reduced Menopause Symptoms**

Isoflavones reduce menopausal problems without any hormone related complexity. Women fed with soy flour (45 g) daily show reduction (40%) in menopause symptoms.

**Prevent Osteoporosis**

Isoflavones are structurally similar to ipriflavones, which inhibit bone resorption in humans. They inhibit proliferation of osteoblast cell line G292 stimulated by EGF and inhibit Ca\(^2+\) influx mediated by thapsigargin.

**Reduce Bone Loss**

Isoflavones prevent and reverse bone loss caused by estrogen deficiency.

**Reduce Cancer Risk**

By competing with the more potent estrogen for binding to the estrogen receptor, weak estrogens are thought to be able to function as antiestrogens. Genistein and glycetin inhibit angiogenesis, the growth of new blood vessels that, when abnormal, can contribute to the development of cancer in vitro work has shown that genistein has a greater antitumorigenesis than daidzein and genistin, which inhibits the growth of a wide range of cancer cells including those that are not hormone-dependent. The proposed explanation for these anticancer effects is the ability of genistein to markedly inhibit the activity of enzymes (tyrosine protein kinase, ribosomal S6 kinase, DNA topoisomerase) that control cell growth and regulation. Although only limited data are available, animal work indicates that genistein inhibits tumor development.

**HPLC Analysis Methods of Isoflavones**

<table>
<thead>
<tr>
<th>Sl.No.</th>
<th>Column size</th>
<th>Solvent system</th>
<th>Flow rate ml/min</th>
<th>Temp. of column °C</th>
<th>Detector</th>
<th>Constituents identified</th>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>ODS-3 (150*3 mm)</td>
<td>Methanol (A) Acetonitrile (B)</td>
<td>0.3</td>
<td>37</td>
<td>*CEAD</td>
<td>All 12 isoflavones</td>
<td>17</td>
</tr>
<tr>
<td>2</td>
<td>RP-C8 (250*4.6 mm)</td>
<td>TFA# (A) Acetonitrile (B)</td>
<td>1.5</td>
<td>40</td>
<td>UV (254 nm)</td>
<td>daidzin, glycetin, genistein, daidzin, genistin.</td>
<td>18</td>
</tr>
<tr>
<td>3</td>
<td>RP-18 (5 μm)</td>
<td>Acetonitrile (A) Acetic acid (B)</td>
<td>0.3</td>
<td>-</td>
<td>UV (254 nm) &amp; PAD</td>
<td>daidzin, glycetin, genistin and malonyl genistin</td>
<td>20</td>
</tr>
<tr>
<td>4</td>
<td>RP-18 (250 μm * 4 μm)</td>
<td>Acetic acid (A) Methanol (B)</td>
<td>0.5</td>
<td>-</td>
<td>UV (254 nm) &amp; PAD</td>
<td>daidzin, glycetin, genistin and malonyl genistin</td>
<td>24</td>
</tr>
<tr>
<td>5</td>
<td>RP-18e (4.6 mm, 100 mm)</td>
<td>Acetic acid (A) Methanol (B)</td>
<td>0.8</td>
<td>-</td>
<td>UV (200-400 nm)</td>
<td>Total isoflavonoids</td>
<td>26</td>
</tr>
<tr>
<td>6</td>
<td>C18 (20 cm*4.6 mm i.d.*5 μm)</td>
<td>Acetonitrile (A) TFA# (B)</td>
<td>1.0</td>
<td>Ambient</td>
<td>UV (262 nm)</td>
<td>Total isoflavonoids</td>
<td>27</td>
</tr>
<tr>
<td>7</td>
<td>C18-YMC –pack ODS AM (5 μm, 25 cm * 4.6 mm)</td>
<td>Acetonitrile (A) TFA# (B)</td>
<td>1.0</td>
<td>22</td>
<td>UV (254 nm)</td>
<td>daidzin, glycetin, genistein, daidzin, genistin, malonyl-daidzin, malonyl-glycitin and malonyl-genistin</td>
<td>28</td>
</tr>
</tbody>
</table>

*Coulometric electrode array detection; #Trifluoroacetic acid*
Inhibit Angiogenesis
Soy isoflavones inhibit angiogenesis, an important step in tumor promotion, and may also provide protection against synthetic estrogen-like compounds, found in pesticides.

Protection against Prostate Problems
Eating isoflavones rich products may protect against enlargement of the male prostate gland. Isoflavones slow prostate cancer growth and cause prostate cancer cells to die. Soy isoflavones also inhibit 5α-reductase, the enzyme that activates testosterone in the prostate gland and other tissues. 5α-Reductase inhibitions represent a potentially effective therapeutic approach to benign prostate enlargement and male pattern baldness. However, isoflavones also exhibit effects that are not related to estrogen activity.

Reduce Heart Disease Risk
Isoflavones inhibit the growth of cells that form artery-clogging plaque that usually form blood clots, which can lead to a heart attack. A review on soy and heart disease concluded that soy as isoflavones is definitely effective for improving cholesterol profile. Isoflavones help to reduce cholesterol levels and prevent gallstone. Soy protein is hypocholesterolemic in individuals with elevated cholesterol. Soy product, from which isoflavones had been removed, had little effect on cholesterol levels in animals compared to the isoflavone-containing soy product. Soy isoflavonoids (genistein and equol) have many positive effects in the treatment of heart and kidney disease, and also replacements for loop-diuretics.

Inhibit Growth Factor
It inhibits transforming growth factor β1-mediated signal transduction. Genistein inhibits platelet aggregation and smooth muscle cell proliferation. Smooth muscle cells are one of the primary cell types comprising plaques.

Effects on Alcohol
Daidzin and daidzein shortened alcohol-induced sleep-time, suppression of appetite for alcohol and also consumption without accelerating the liver enzyme.

Inhibit Lipid Peroxidation
Tempe, a fermented soybean product, has the capacity to inhibit the lipid peroxidation due to presence of isoflavones as well as decreased the total amount of aldehyde excretion.

Acting as a Bio-monitor
Total isoflavone content of soybean seeds increases, if it grows under elevated CO2 experienced (p<0.005), while total isoflavone content decreases, if the elevated O2 experienced (p<0.05). Thus CO2 or O2 can cause changes in isoflavone concentration.

Prevents Wilson's disease and Hemochromatosis
Isoflavonoids may play an important role in metal-overload diseases [Wilson’s disease (copper overload) and hemochromatosis (iron overload)] and also in all oxidative stress conditions involving a transition metal ion.

Other Physiological Importance of Isoflavones
Antioxidants also play an important role in brain aging and may prevent progressive cognitive impairments. Vitamin E supplementation showed an intracellular effect in monocytes that are antiatherogenic. Genistein is known to influence mitogenesis, cell-cycle regulation, cell survival, cell death, antifungal activity and cellular transformation. Flavonoids in plants participate in light-dependent phase of photosynthesis when they catalyze electron transport. Flavonoids function as antioxidants and UV light filters in higher plants.

Adverse Effects of Isoflavones
Soy isoflavones, genistein and daidzein, inhibit thyroid peroxidase and 5’-deiodinase, key enzymes involved in thyroid hormone biosynthesis. The inhibition of these enzymes results in decreased levels of circulating thyroid hormones that leads to increased secretion of thyroid stimulating hormone (TSH) by the anterior pituitary. The increased levels of TSH provide a growth stimulus to the thyroid, resulting in goiter. Genistein, at high concentrations in vitro induces chromatid breaks, gaps, and interchanges in human lymphocytes (chromatid). Also, genistein inhibits cyclic AMP-mediated release of lipoprotein lipase activity from fat pads. Reproductive problems, infertility, thyroid disease and liver disease due to dietary intake of isoflavones have been observed. Infants fed soy formula may experience negative effects on general health or reproduction later in life, because isoflavones influence the activity of certain hormones. A recent study of over 800 young adults who (as infants) were fed either soy formula or cow's milk formula; however, found that...
there were no differences between the two groups in
over 30 different parameters measured, including
fertility and general health\textsuperscript{59}.

\textbf{Intake}

Daily exposure of infants to isoflavones in soy
infant formula is 6-11 times higher on a body weight
basis than the dose that has hormonal effects in adults
consuming soy foods\textsuperscript{58}. Isoflavones concentration in
infants fed soy-based formula was 13,000-22,000
times higher than plasma estradiol concentrations in
infants fed cows’ milk formula. Using food
consumption data in Japan\textsuperscript{60}, intakes of soy products
and isoflavones were reported positively correlated
with mortality from colorectal cancer. There is a
significant effect of soy diet or isoflavone supplement
(Table 5) inhibiting the formation of Colonic Aberrant
Crypt Foci (ACF)\textsuperscript{61}.

\textbf{Deodourization and Detoxification of Soybeans}

A number of soybean isoflavone products\textsuperscript{62,63}
have been commercialized (Table 6). Unprocessed
soybeans contain unfavorable compounds and
unpleasant odour. Certain compounds lock or inhibit
digestion of nutrients. Soy protein isolate (SPI) is a
convenient and effective method for deodourizing the
typical odour of soybeans. In SPI deodorizing
method, various types of solid adsorbents made of
polystyrene, polymethacrylate, and zeolite, as well as
charcoal are used. Treatment of the SPI solution
decreased hexanal content in the solution, whereas
linoleic acid was not decreased much. Hexanal in the
SPI solution can be classified into two types. Hexanal
of type I may be free or bound weakly on the surface
of proteins and is removable by the adsorbents,
whereas hexanal of type II may be bound tightly
inside proteins and is unremovable by the adsorbents.
Type I hexanal may be closely related to the soybean
odor. Removal of hexanal by the adsorbents was not
much improved by chymotryptic digestion of SPI. Type II hexanal might be in similar states even in the
chymotryptic digests\textsuperscript{64}.

\textbf{Conclusions}

Soy isoflavones are important to cure breast cancer,
menopausal syndromes, heart diseases, LDL -
cholesterol, osteoporosis, kidney diseases,
angiogenesis problem, prostate problem, tumor risk
etc. Except this, it has some antimicrobial properties.
But the infants and persons allergic to soy foods are
not advisable to take isoflavones through different
forms of soy foods. Excess intake of isoflavones
(> 600 mg in daily diet) is toxic.

Precise metabolic pathways of isoflavones in
human system need further study. Most of the
research on isoflavones targeted to purification and
isolation of isoflavone compound. The disease control
activity of naturally occurring isoflavone delivered by
a food product has not been well studied in India. The
investigations of impact of cooking and processing of
soy foods on these bioactive constituents is badly
lacking especially harsh cooking practices in India or
widely emerging microwave cooking.

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\begin{table}[h!]
\centering
\begin{tabular}{|c|c|c|}
\hline
\textbf{Dosage of Isoflavones} & \textbf{Ailments} \\
\hline
1-2 scoops twice a day mixed with juice & Alcoholism \\
Follow package instructions (usually 2 & Cancer \\
scoops twice a day, mixed with juice) & \\
50-100 mg once or twice a day & Menopause \\
50-100 mg once or twice a day & Perimenopause \\
2,500 mg capsules (standardized to contain 5% soy Isoflavones) each morning & Prostate problems \\
50 mg of once a day & Cholesterol problem \\
40-80 mg once a day & Cardiovascular health \\
\hline
\end{tabular}
\caption{Isoflavone dosage of different ailments\textsuperscript{61}}
\end{table}

\begin{table}[h!]
\centering
\begin{tabular}{|c|c|c|}
\hline
\textbf{Sl No} & \textbf{Company} & \textbf{Products} & \textbf{Comments} \\
\hline
1 & Viva Herba Private Ltd & SFS soya deoiled cake & Animal feed \\
 & & & ingredients \\
2 & Alembic Ltd\textsuperscript{62} & Isovon capsules & For menopausal health \\
3 & ProSoya Foods (India) Pvt Ltd & Staeta Soya Milk & Health drink \\
4 & Sabinsa Corporation\textsuperscript{63} & Policosanol, Galanga extract, & Dietary \\
 & & SabiWhite\textsuperscript{TM} and & supplement and \\
 & & soy isoflavones & cosmetic products \\
\hline
\end{tabular}
\caption{Commercial Products of soybean isoflavones}
\end{table}
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