Operational Guidelines for the Addition of Milk Thistle Extract Various Application Fields

I. Preface

Milk Thistle Extract is a natural flavonolignan complex extracted from the dried fruits of *Silybum marianum* (Asteraceae). Its core active component is silymarin, which mainly consists of four major fractions: silybin, isosilybin, silychristin and silydianin. Among them, silybin has the strongest activity, accounting for 50%-70% of the total silymarin. The extract exhibits significant antioxidant, hepatoprotective, anti-inflammatory and soothing effects, and is widely used in health supplements, pharmaceuticals, food and beverages, cosmetics, animal husbandry and other fields.

Based on national standards and industry practical experience, this guideline specifies the addition methods, dosage ranges, operational key points and safety norms for the extract in various application fields. It aims to provide detailed and actionable operational basis for manufacturing enterprises, ensuring stable product efficacy and compliance with quality standards. This guideline applies to Milk Thistle Extract (in powder or liquid form) with a purity of ≥80%; parameters for products with special specifications shall be adjusted according to their own characteristics.

II. Core Basic Information

2.1 Key Parameters

- Active component: Silymarin (core index); high-end products may have a silybin content of ≥30% to improve bioavailability.
- CAS No.: 84604-20-6 for mixed extract (water/ethanol solvent); 22888-70-6 or 65666-07-1 for pure silymarin.
- Appearance and form: Commonly pale yellow to brown powder (food grade, feed grade) or liquid extract (cosmetic, pharmaceutical fields).
- Solubility: Easily soluble in organic solvents such as ethanol and propylene glycol, slightly soluble in water. Powder form needs to be dispersed with solvents before addition to ensure uniformity.

2.2 Pretreatment Requirements

▪ Powder extract: Sift through an 80-100 mesh sieve before use to remove agglomerates and impurities to avoid affecting product uniformity. For aqueous systems, dissolve the powder with 5-10 times the amount of food/medicinal grade ethanol to prepare a stock solution, which is then gradually diluted for addition.

▪ Liquid extract: Stir thoroughly before use and test the solid content (usually 30%-50%). Convert the addition amount according to the actual concentration to avoid uneven efficacy caused by stratification.

▪ Compatibility test: When applying the extract to a new formula for the first time, conduct a small-scale test in advance to verify its compatibility with other ingredients (e.g., preservatives, acids, alkalis, metal ions) and prevent precipitation, discoloration, efficacy attenuation and other issues.

III. Addition Methods and Operational Norms in Various Application Fields

3.1 Health and Dietary Supplements

3.1.1 Application Scenarios

Mainly used in hepatoprotective products such as capsules, tablets, oral liquids and granules. It can be used alone or compounded with curcumin, Schisandra chinensis extract, etc., to enhance hepatoprotective efficacy.

3.1.2 Addition Methods

- Capsules: Mix the sieved Milk Thistle Extract powder with fillers (lactose, starch) and disintegrants (crospovidone) in proportion to achieve uniform mixing. Use the equal incremental mixing method when the extract accounts for ≤20%. For a higher proportion, adsorb the extract with colloidal silicon dioxide first before mixing, then fill the mixture into hard capsules.
- Tablets: Mix the extract powder with excipients, add a binder (povidone K30 aqueous solution) for granulation, dry the granules at a temperature ≤60℃ (to avoid degradation of active components), size the granules, add a lubricant (magnesium stearate) for total mixing, and then compress into tablets. For film-coated tablets, control the coating temperature at ≤45℃ and select gastric-soluble coating materials.
- Oral liquids: Use liquid extract or powder extract stock solution, add sweeteners (sorbitol, steviol glycosides) and food-grade preservatives (sodium benzoate), stir to dissolve, make up the volume, homogenize at 20-30MPa, and filter to ensure a clear and precipitate-free system.

3.1.3 Dosage Range

Calculated by silymarin content, the recommended daily intake is 200-400mg. Corresponding product addition amounts: 50-100mg of 80% silymarin extract per 0.5g capsule; 40-80mg per 0.3g tablet; 100-200mg of silymarin per 100mL oral liquid.

3.1.4 Operational Key Points

Conduct the mixing process in a dry environment (relative humidity ≤60%) to prevent the extract from absorbing moisture and agglomerating. Strictly control the drying temperature to avoid oxidative degradation of silymarin. The finished products shall be hermetically packaged, stored in a cool and dark place, with a shelf life of usually 2 years.

3.2 Pharmaceutical Field

3.2.1 Application Scenarios

Used as a raw material for drugs treating liver diseases such as acute/chronic hepatitis, fatty liver and liver cirrhosis, including hepatoprotective tablets, injectable preparations and soft capsules.

3.2.2 Addition Methods

- Oral solid preparations (tablets, capsules): Adopt the same process as health supplements, but comply with pharmaceutical grade standards. Select pharmaceutical grade excipients (e.g., pharmaceutical starch, lactose), and the mixing uniformity shall meet pharmacopoeia requirements (content uniformity RSD ≤3%).
- Injectable preparations: Use high-purity silymarin (purity ≥98%), dissolve it with medicinal ethanol to prepare a stock solution, dilute with water for injection, adjust the pH value to 5.0-7.0, add activated carbon (0.1%-0.2%) to adsorb impurities, stir for 30 minutes, filter to remove carbon, and then perform aseptic filling and sterilization (121℃, 15 minutes).
- Soft capsules: Mix the extract with pharmaceutical grade vegetable oils (soybean oil, olive oil), heat to 40-50℃ and stir to dissolve to prepare the contents. Produce soft capsules by compression or dropping method, and control the moisture content of the capsule shell at 8%-12%.

3.2.3 Dosage Range

Pharmaceutical grade preparations shall be added in accordance with the prescription strictly following pharmacopoeia standards. Generally, each tablet contains 35-70mg of silymarin, with the daily dose taken in 2-3 divided times; each 2mL injection contains 20-40mg of silymarin for intravenous infusion.

3.2.4 Operational Key Points

The production environment shall comply with GMP standards with a cleanliness class of ≥100,000. Raw materials shall undergo strict testing to meet the limits of heavy metals (Pb ≤0.5ppm, Cd ≤0.1ppm) and microorganisms (bacterial count ≤100cfu/g). Monitor the pH value and dissolution temperature throughout the preparation process to

ensure product stability and safety.

3.3 Food and Beverage Field

3.3.1 Application Scenarios

Used as a natural antioxidant, preservative and functional ingredient in meat products, beverages, baked foods, dried fruits, etc., to extend shelf life and enhance product functionality.

3.3.2 Addition Methods

- Meat products (sausages, ham, cured meat): Dissolve the extract powder with food-grade ethanol to prepare a stock solution, add it to the meat stuffing together with auxiliary materials such as salt and white sugar, and stir evenly (stirring speed 30-50r/min, time 5-10 minutes) to ensure uniform penetration. Then conduct pickling, cooking and cooling according to conventional processes.
- Beverages (functional drinks, fruit juices, tea drinks): Add liquid extract or powder stock solution during the beverage blending stage. First dilute with a small amount of water or solvent, then gradually add to the main liquid, stir evenly, homogenize at 15-25MPa, filter, fill and perform pasteurization (85℃, 15 seconds).
- Baked foods (bread, biscuits, cakes): Add the extract powder together with flour, sugar, oil and other auxiliary materials during dough or batter preparation, mix evenly, control the dough temperature at 25-30℃, adjust the fermentation time according to the formula, and bake at a temperature ≤180℃ to avoid loss of active components due to high temperature.
- Dried fruits (raisins, dried mango): Dissolve the extract in the soaking solution (citric acid can be added to adjust acidity) during the soaking stage before drying. Soak the fruit pieces for 2-4 hours, fish them out and dry according to conventional processes (temperature 50-60℃) to make the extract adhere to the fruit surface and improve antioxidant and fresh-keeping effects.

3.3.3 Dosage Range

The recommended addition amount is 0.1%-0.5% of the total food mass for powder extract (calculated by mass), and the amount of liquid extract shall be converted according to solid content. Specific subdivisions: 0.1%-0.3% for meat products, 0.2%-0.5% for beverages, 0.5%-1.0% for baked foods, and 0.3%-0.5% for dried fruits.

3.3.4 Operational Key Points

Select food-grade extract complying with relevant standards such as GB 1886.313-2021. Avoid direct contact with strongly acidic (pH<3.0) and strongly alkaline (pH>9.0)

ingredients during addition to prevent decomposition of active components. Control the temperature and time during baking and sterilization to maximize the retention of antioxidant activity.

3.4 Cosmetics and Skin Care Products Field

3.4.1 Application Scenarios

Utilizing its antioxidant, anti-inflammatory, whitening and soothing effects, it is used in serums, creams, facial masks, toners, shampoos and other products to delay skin aging and improve sensitive skin conditions.

3.4.2 Addition Methods

- Creams and lotions: Add Milk Thistle Extract(powder form needs to be dissolved in propylene glycol/glycerol to prepare a stock solution first) at the late emulsification stage when the system temperature drops to 40-45℃, stir evenly (stirring speed 80-100r/min, time 10-15 minutes), continue cooling to room temperature, and homogenize at 10-20MPa to ensure a stable and particle-free system.
- Serums and toners: In aqueous systems, first dissolve the extract in a small amount of ethanol or propylene glycol, add deionized water, stir to dissolve, then add preservatives (phenoxyethanol) and humectants (hyaluronic acid), adjust the pH value to 5.5-6.5, filter to clarify and fill.
- Sheet masks: Add the extract stock solution to the mask liquid, mix evenly with hyaluronic acid, vitamin C and other ingredients, soak the mask cloth in the liquid, and perform vacuum negative pressure adsorption for 30 minutes to ensure the mask cloth fully absorbs the essence, then seal and package.
- Shampoos and conditioners: Add the extract powder together with surfactants (sodium laureth sulfate) and conditioners (cationic guar gum) to deionized water during shampoo preparation, heat to 50-60℃ and stir to dissolve, cool to below 35℃, add essence and preservatives, stir evenly, filter and fill.

3.4.3 Dosage Range

The recommended addition amount is 0.5%-2.0% of the total product mass, specifically: 1.0%-2.0% for creams and serums, 0.8%-1.5% for toners and facial masks, and 0.5%-1.0% for shampoos and conditioners. For sensitive skin products, the amount is recommended to be controlled at 0.5%-1.0% to avoid irritation.

3.4.4 Operational Key Points

Control the product pH value at 5.0-7.0 to avoid damage to active components by acidic or alkaline environments. Avoid compounding with high-concentration vitamin C and fruit acids to prevent oxidative discoloration. Maintain a clean production environment to avoid microbial contamination. The finished products shall undergo stability tests

(stored at room temperature, 45℃ and under light for 3 months to observe changes in appearance and odor).

3.5 Animal Husbandry Field

3.5.1 Application Scenarios

Used as a natural hepatoprotective and antioxidant feed additive for large animals such as dairy cows, beef cattle and pigs to prevent liver damage caused by moldy feed, alleviate stress responses and improve breeding efficiency.

3.5.2 Addition Methods

- Compound feed: Mix the Milk Thistle Extract powder with basal feed (corn, soybean meal, wheat bran) and premix (vitamins, minerals) in proportion, and perform mechanical stirring (stirring speed 100-150r/min, time 15-20 minutes) to ensure mixing uniformity (coefficient of variation ≤7%). The mixture can be made into pelleted or powdered feed.
- Addition to drinking water: Dissolve the extract powder with warm water (30-40℃) to prepare a stock solution, add it to the breeding water supply system in proportion, and start the circulating stirring device to ensure the extract is evenly contained in the drinking water. This method is suitable for animals in the stress period (e.g., after transportation and calving).
- Targeted conditioning: For animals with moldy feed poisoning or abnormal liver function, prepare a special premix (extract + corn cob powder carrier) alone, feed it separately or mix it into the feed according to the dosage, with a conditioning cycle of 7-14 consecutive days.

3.5.3 Dosage Range

Adjust according to animal species and growth stage: 2‰-3‰ (calculated by silymarin) added to dairy cow concentrate, 1.5‰-2.5‰ to beef cattle fattening feed, 0.4g/kg to piglet nursery feed, and 1‰-1.5‰ to multiparous sow feed. The dosage can be appropriately increased to 1.5 times the normal value during the stress period for 3-5 consecutive days.

3.5.4 Operational Key Points

Fully mix the extract with feed to avoid local excessive or low concentration. Do not mix the extract directly with moldy feed; handle the moldy feed first or use it with a mold remover. Store the extract separately from feed in a hermetically sealed and moisture-proof container to prevent moisture absorption and agglomeration affecting the use effect.

3.6 Other Fields (Chemical Industry, Textile Industry)

3.6.1 Chemical Industry

Used as a stabilizer for chemical products and an auxiliary component of catalysts to prevent oxidative deterioration of chemical products. Addition method: Add at the initial stage of the reaction system according to the type of chemical reaction. The dosage shall be determined through preliminary experiments, usually 0.5%-3.0% of the total system mass. Monitor the reaction temperature and pH value throughout the process and observe the system stability.

3.6.2 Textile Industry

Used as a textile post-treatment agent to improve the moisture retention and antioxidant properties of fabrics. Addition method: After textile dyeing and before setting, dissolve the extract in the treatment liquid (dispersant can be added), impregnate the textiles in the liquid (bath ratio 1:20, temperature 40-50℃) for 30-60 minutes, fish them out, and then dry and set. The dosage is adjusted according to the fabric material with no fixed standard, subject to the fabric achieving the expected moisture retention effect.

IV. Quality Control and Safety Norms

4.1 Quality Inspection Indicators

- Active component content: Total silymarin ≥80%, silybin ≥40% (≥30% for high-end products), detected by High Performance Liquid Chromatography (HPLC).
- Impurity control: Heavy metals (Pb ≤0.5ppm, Cd ≤0.1ppm, Hg ≤0.01ppm); microorganisms (food grade: bacterial count ≤100cfu/g, mold and yeast ≤10cfu/g; pharmaceutical grade: sterile); solvent residue (ethanol ≤500ppm).
- Appearance and stability: The powder shall be free of obvious agglomeration and peculiar smell; the liquid shall be free of stratification and turbidity. The finished products shall pass the accelerated stability test (stored at 45℃ and RH75% for 6 months) with an active component retention rate of ≥90%.

4.2 Safe Operation Norms

1. Operators shall wear protective gloves and masks to avoid direct contact of the extract with skin and mucous membranes. In case of accidental contact, rinse immediately with a large amount of clean water.
2. Avoid storing and using the extract with strong oxidants, strong acids and alkalis during production to prevent chemical reactions.
3. Storage conditions: Hermetically packaged and stored in a cool and dry place (temperature ≤25℃, relative humidity ≤60%), protected from light and moisture, and kept away from fire sources. The shelf life is 2 years (unopened); use up within 3 months after opening.

4. Waste disposal: Waste generated during production (e.g., filter residue) shall be disposed of as general industrial waste or domestic waste in compliance with environmental protection standards.

V. Notes

1. The recommended dosages in this guideline are for general use; the actual addition amount shall be optimized through small-scale tests combined with product formula, efficacy requirements and production process to determine the optimal parameters.
2. Milk Thistle Extract is sensitive to high temperature and strong light. Strictly control the temperature and light during production and storage to avoid degradation of active components.
3. The purity and proportion of active components of extracts from different manufacturers may vary. After changing suppliers, conduct small-scale tests again and adjust the addition amount and process accordingly.
4. Select extracts of the corresponding grade for pharmaceutical and food grade products, and strictly follow relevant national standards and pharmacopoeia standards to ensure product compliance.

VI. Supplementary Provisions

This guideline shall come into force on the date of issuance and be interpreted by the enterprise's technical department. In case of updates to industry standards and national standards or expansion of application scenarios, the content of this guideline shall be revised in a timely manner to ensure its applicability and professionalism.