INTRODUCTION

Kvatha one of the most popular Kalpana among five basic Kalpanas widely used therapeutically (to cure the different ailment) as well as pharmaceutically (used to prepare the different dosage forms like Ghana, vati, syrup, etc. Although a clear description is not available in Vedic literature, a detailed description is present in all Samhitas regarding its preparation, amount of water, and reduction in volume of liquid. Kvatha Kalpana may be defined as a Kalpana in which a specific quantity of Kvatha Dravya is taken and specific amount of water is used as menstruum and applying specific quantum of heat, the volume of water is reduced to specific amount and then by filtering Kvatha can be obtained [1].

Trikantakadi kvatha (TK) is an aqueous extract hence it is always questioned against its stability period. Hence, that modification in the dosage form was attempted in the present study and modified dosage forms such as TK syrup (TKS), Trikantakadi tincture (TT), and TK Ghana Vati (TKGV) were prepared. To ensure the stability period of prepared dosage form, the stability study was done and compared the observed value of all the physicochemical properties with the previous data.

CHRONICLED APPRAISAL

Reference is cited for Kvatha Dravya along with nature and various proportion of water taken for the preparation of kvatha (aqueous extract) (Table 1a). In Ayurveda Sar Sangraha and Rasatantrasara Va Sidhapatyogam Sangraha mentioned the use of TK in Asmari, Mutrakricha, Mutraghat and to remove the kidney stones outside the body (Table 1b) [7,8].

METHODS

All the raw herbs are collected from the local market of Jalandhar and authentication is carried out by Dr. Satwinderjeet Kaur, Head, Department of Botanical and Environmental Sciences, Guru Nanak Dev University Amritsar, Punjab, with ref. no. 1088, dated 18.10.2016. Microscopic analysis of raw materials was studied according to the methods of the Quality Standard of Indian Medicinal Plant (Tables 2 – Figs. 1-6 and Table 3 – Figs. 7-12) [9].

Method of preparation

Preparation of TK

TK was prepared according to the procedure mentioned in the Ayurveda Sar Sangraha [7].

TKS

500 g of sugar candy powder was added to previously prepared TK (1000 ml) Citric acid (0.1 g), propylparaben (2 g), and methylparaben (2 g) were used as a preservative.

TKGV

Granules were prepared from 80 g of TKG and mix 80 g of a mixture of herbal drugs (TK) powder for making the tablet 550 mg by adding

| Reference book | Nature of drugs/quantity of drugs | Quantity of water | Reduction up to |
|----------------|---------------------------------|------------------|-----------------|
| Charaka Samhita [2] | + tula (48 g) | 16 times | 1/8th |
| Sushruta Samhita [3] | - | 16 times | 1/4th |
| Astanga Samhagha [4] | - | 8 times | 1/4th |
| Sharangdhara Samhita [5] | Madhyam | 16 times | 1/8th |
| Yogaratangini [6] | - | 26 times | 1/8th |
Table 1b: Literature review on TK

| Name of drugs | Common name | B. N. and family | Part used | A. S. S. | R. Va S. S. | Quantity |
|---------------|-------------|------------------|-----------|----------|-------------|----------|
| Gokshura      | Gokhru      | Tribulus terrestris Linn. | Fruit    | +        | +           | 1 Part   |
| Amaltaas ka gudha (pulp) | Girimaal, Amaltaas | Cassia fistula Linn. | Fruit pulp | +        | +           | 1 Part   |
| Darbhamoola   | Doob        | Gynodon daucylon Linn. | Root      | +        | +           | 1 Part   |
| Damasha/javasha | Javasa    | Alhagi camelorum (Bieb). Desv. | Whole part | +        | +           | 1 Part   |
| Pashan bheda  | Silphara, Pakhanabheda | Bergenia ligulata (Haw.) Sternb. Saxifragaceae | Root      | +        | +           | 1 Part   |
| Harar         | Harad, Harre | Terminalia chebula Retz. Combretaceae | Fruit     | +        | +           | 1 Part   |
| Kaasmoold     | Kasa, Kans  | Saccharum spontaneum Linn. Poaceae | Root      | +        | +           | 1 Part   |
| Pitpapda      | Dhangajra    | Fumaria vaillantii Lmn. Fumaraceae | Whole plant | +        | -           | 1 Part   |

B.N: Botanical name, R. Va S. S.: Rasatantrasara Va Sidhaprayoga Sangraha, A. S. S.: Ayurveda Sar Sangraha, TK: Trikantakadi kvatha

Table 2: Microscopical characters of Raw materials

Table 3: Microscopical characters of TK churna

Table 4: Master formula of formulations

| Formulations | Quantity | Ingredients (g) | Other excipients (%) |
|--------------|----------|----------------|----------------------|
| TK           |          | G 62.5           | A 62.5, D 62.5, J 62.5, P 62.5, H 62.5, Pa 62.5, K 62.5 | Nil |
| TKS          |          | G 62.5           | A 62.5, D 62.5, J 62.5, P 62.5, H 62.5, Pa 62.5, K 62.5 | Preservative (50 S, 0.01 CA, 0.2 PP and MP) (% w/v) |
| TKGV         |          | G 20             | A 20, D 20, J 20, P 20, H 20, Pa 20, K 20 | Gum acacia-4 (% w/w) |
| TT           |          | G 25             | A 25, D 25, J 25 | Ethanol-15 (% v/v) |

TK: Trikantakadi kwatha, TKS: Trikantakadi kwatha syrup, TKGV: Trikantakadi kwatha Ghana vati, TT: Trikantakadi tincture, G: Gokshura, A: Amaltaas, D: Darbhamoola, J: Javasa, P: Pashanabheda, H: Harar, Pa: Parpata, K: Kaasmoold, S: Sugar, CA: Citric acid, PP: Propylparaben, MP: Methylparaben
6.4 g of gum acacia as binding agent and were compressed into tablet form [10].

TT

850 ml (water) and 150 ml (ethanol) were taken together, and then, 200 g of TK Draya added. The entire wort was kept for extraction for the time period of 14 days (Table 4) [11].

Characterization of formulation

Determination of organoleptic characteristics such as color, odor, taste, and state of prepared formulations was carried out (Table 5 – Figs. 13-16). All the physicochemical parameters of prepared formulations were carried out, and results of the experiment are asserted in Tables 6 and 7 [12-14]. Phytochemical analysis and thin-layer chromatography (TLC) of formulation were performed.

Table 5: Organoleptic characters of formulations

| Organoleptic character | TK         | TKS        | TT         | TKGV     |
|------------------------|------------|------------|------------|----------|
| Color                  | Dark brown | Dark brown | Brown      | Dull brownish |
| Odor                   | Characteristics | Characteristics | Alcoholic fragrance | Characteristics |
| State                  | Liquid     | Liquid     | Liquid     | Solid    |
| Taste                  | Tikta, kashaya | Madhura, tikta | Kashaya, tikta | Kashaya, tikta |

Fig. 13: Trikantakadi Kvatha
Fig. 14: Trikantakadi Kvatha syrup
Fig. 15: Trikantakadi tincture
Fig. 16: Trikantakadi Kvatha Ghana Vati

Table 6: Physicochemical parameters of formulations

| Parameters                     | Batch | Kvatha | Syrup | Tincture |
|--------------------------------|-------|--------|-------|----------|
| Total ash (% w/w)              |       | K1     | K2    | K3 Avg.  | S1     | S2    | S3 Avg. | T1    | T2    | T3 Avg. |
| Acid insoluble ash (% w/w)     | 0.3   | 0.4    | 0.5   | 0.4  | 0.1  | 0.1  | 0.2  | 0.13  | 0.5  | 0.5  | 0.5  |
| Total solid content (% w/v)    | 19.32 | 19.31  | 19.33 | 19.32 | 41.82 | 43.58 | 41.98 | 42.47 | 3.5  | 3.2  | 3.24 |
| pH meter                       | 4.77  | 4.77   | 4.78  | 4.77 | 4.58 | 4.59 | 4.59 | 4.58 | 4.76 | 4.75 | 4.76 |
| Sp. Gravity at 25°C (g/ml)      | 1.028 | 1.029  | 1.028 | 1.028 | 1.208 | 1.179 | 1.181 | 1.189 | 1.003 | 1.004 | 1.003 |
| Viscosity (millipoise)         | 1.379 | 1.350  | 1.352 | 1.351 | 1.346 | 1.347 | 1.347 | 1.346 | 1.35 | 1.35 | 1.34 |
| Refractive index at room temp.  | 1.351 | 1.352  | 1.352 | 1.351 | 1.346 | 1.347 | 1.347 | 1.346 | 1.35 | 1.35 | 1.34 |
| Alcohol content                | NA    | NA     | NA    | NA     | NA    | NA    | NA    | 3     | 3     | 3     | 3     |
| Total acidity (%v/v) titrimetric method | NA    | NA     | NA    | NA     | 0.047 | 0.048 | 0.047 | 0.047 | 0.029 | 0.027 | 0.029 |
| Total sugar (%v/v)            | NA    | NA     | NA    | NA     | 8.46  | 8.45  | 8.45  | 8.45  | 10.6  | 10.5  | 10.4  |
| Reducing sugar (%v/v)         | NA    | NA     | NA    | NA     | 2.77  | 2.88  | 3.15  | 2.9   | 2.77  | 3.01  | 2.78  |
| Non-reducing sugar (%v/v)     | NA    | NA     | NA    | NA     | 5.40  | 5.52  | 5.80  | 5.57  | 7.43  | 7.88  | 7.88  |

NA: Not applicable

Table 7: Test for tablets

| Parameters                      | Observed result |
|---------------------------------|-----------------|
| Appearance                      | Dull-brownish color, smooth surface |
| Shape                           | Round           |
| Hardness                        | 4 kg/inch²      |
| Thickness and diameter          | 4 mm, 10.5 mm   |
| Friability                      | 1.001% w/w      |
| Weight variation                | 1.8% w/w        |
| Disintegration time             | 14 minutes      |

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Stability study of TKS, TT, and TKGV at accelerated temperature conditions was performed (Table 10) [16].

**OBSERVATION AND RESULT**

Pharmacognostic, physicochemical, phytochemical parameters of all the raw ingredients and formulations were studied, it showed that all the chemical compounds that were present in the Kwath (TK) were also present in other prepared dosage form. Stability studies of various prepared dosage forms of *trikantakadi kwath* was done for the time period of three days and during the stability studies of the various physicochemical, phytochemical and Thin Layer Chromatographic studies were done within the specific interval of time. Stability studies showed no significant variation when compared the observed results of accelerated temperature conditions data with the previous data.

**Method for stability study**

Stability study was performed by keeping the prepared samples at accelerated temperature conditions. Nine samples of each prepared dosage forms were taken and kept it at accelerated temperature of 4°C and room temperature of 47°C. The samples were tested for the physicochemical properties like color, odor, pH, specific gravity, friability, weight variation, hardness, etc. at the interval of 24 hrs, 48 hrs, and 72 hrs to observing the changes in physicochemical properties (Table 10).

**DISCUSSION**

TK was prepared by classical method mentioned in literature and converted into TKS, TKGV, and TT. Precaution should be taken during the processing of formulations. TT placed at dark place in airtight container. Physicochemical (Tables 6 and 7) and phytochemical investigation (Table 8) not showed any remarkable changes in physicochemical properties when compared with the previous data (Tables 6-8). Hence, these results may make some improvement in stability and shelf life degradation studies.

**CONCLUSION**

TK is a polyherbal formulation used for treating the Ashmari, Mutraghat, and Mutakricha. Using stander TK as base, various conventional dosage forms can be prepared. Physicochemical, phytochemical parameters, and TLC showed all chemical compounds that present in the Kwath are also present in other prepared dosage form. Stability studies showed no remarkable variation with physicochemical properties when comparing the observed values, which done in the interval of 24 hrs, 48 hrs, and 72 hrs.
Table 10: Stability studies through Physicochemical parameters of TKS, TT, and TKGV

| Sample code | Time duration (in hour) | Temperature (°C) | Physicochemical parameters |
|-------------|------------------------|------------------|---------------------------|
|             |                        |                  | C  | O  | Ts | pH | Sp. | R  | V  | Tu | H  | Ha | F  | W  | D.T. |
| SA1         | 24 hrs                 | 4°C              | NC | NC | NC | 4.58 | 1.18 | 1.346 | 5.6 | X  | Y  | NA | NA | NA | NA |
| TA1         |                        |                  | NC | NC | NC | 4.76 | 1.00 | 1.342 | 1.3 | X  | Y  | NA | NA | NA | NA |
| TaA1        |                        | Room temperature | NC | NC | NA | 4.76 | 1.00 | 1.342 | 1.3 | X  | Y  | NA | NA | NA | 1.001 |
| SA2         |                        | Room temperature | NC | NC | NA | 4.58 | 1.18 | 1.346 | 5.6 | X  | Y  | NA | NA | NA | NA |
| TA2         |                        |                  | NC | NC | NA | 4.76 | 1.00 | 1.342 | 1.3 | X  | Y  | NA | NA | NA | NA |
| TaA2        |                        |                  | NC | NC | NA | 4.58 | 1.17 | 1.346 | 5.6 | X  | Y  | NA | NA | NA | NA |
| SA3         | 47°C                   |                  | NC | NC | NA | 4.76 | 1.00 | 1.342 | 1.3 | X  | Y  | NA | NA | NA | NA |
| TA3         |                        |                  | NC | NC | NA | 4.76 | 1.00 | 1.342 | 1.3 | X  | Y  | NA | NA | NA | NA |
| TaA3        |                        |                  | NC | NC | NA | 4.58 | 1.17 | 1.346 | 5.6 | X  | Y  | NA | NA | NA | NA |
| SB1         | 48 hrs                 | 4°C              | NC | NC | NA | 4.58 | 1.17 | 1.346 | 5.6 | X  | Y  | NA | NA | NA | NA |
| TB1         |                        |                  | NC | NC | NA | 4.76 | 1.00 | 1.342 | 1.3 | X  | Y  | NA | NA | NA | NA |
| TaB1        |                        |                  | NC | NC | NA | 4.58 | 1.17 | 1.346 | 5.6 | X  | Y  | NA | NA | NA | NA |
| SB2         |                        | Room temperature | NC | NC | NA | 4.58 | 1.17 | 1.346 | 5.6 | X  | Y  | NA | NA | NA | NA |
| TB2         |                        |                  | NC | NC | NA | 4.76 | 1.00 | 1.342 | 1.3 | X  | Y  | NA | NA | NA | NA |
| TaB2        |                        |                  | NC | NC | NA | 4.58 | 1.18 | 1.346 | 5.6 | X  | Y  | NA | NA | NA | NA |
| SB3         | 47°C                   |                  | NC | NC | NA | 4.76 | 1.00 | 1.342 | 1.3 | X  | Y  | NA | NA | NA | NA |
| TB3         |                        |                  | NC | NC | NA | 4.58 | 1.18 | 1.346 | 5.6 | X  | Y  | NA | NA | NA | NA |
| TaB3        |                        |                  | NC | NC | NA | 4.76 | 1.00 | 1.342 | 1.3 | X  | Y  | NA | NA | NA | NA |
| SC1         | 72 hrs                 | 4°C              | NC | NC | NA | 4.58 | 1.17 | 1.346 | 5.6 | X  | Y  | NA | NA | NA | NA |
| TC1         |                        |                  | NC | NC | NA | 4.76 | 1.00 | 1.342 | 1.3 | X  | Y  | NA | NA | NA | NA |
| TaC1        |                        |                  | NC | NC | NA | 4.58 | 1.17 | 1.346 | 5.6 | X  | Y  | NA | NA | NA | NA |
| SC2         |                        | Room temperature | NC | NC | NA | 4.76 | 1.00 | 1.342 | 1.3 | X  | Y  | NA | NA | NA | NA |
| TC2         |                        |                  | NC | NC | NA | 4.58 | 1.17 | 1.346 | 5.6 | X  | Y  | NA | NA | NA | NA |
| TaC2        |                        |                  | NC | NC | NA | 4.76 | 1.00 | 1.342 | 1.3 | X  | Y  | NA | NA | NA | NA |
| SC3         | 47°C                   |                  | NC | NC | NA | 4.58 | 1.18 | 1.346 | 5.6 | X  | Y  | NA | NA | NA | NA |
| TC3         |                        |                  | NC | NC | NA | 4.76 | 1.00 | 1.342 | 1.3 | X  | Y  | NA | NA | NA | NA |
| TaC3        |                        |                  | NC | NC | NA | 4.58 | 1.18 | 1.346 | 5.6 | X  | Y  | NA | NA | NA | NA |

C: Color; O: Odor; Ts: Taste; Sp.: Specific gravity at room temperature [g/ml]; R: Refractive index at room temperature; V: Viscosity (milliPoise); Tu: Turbidity; H: Homogeneity; Ha: Hardness (Kg/inch square); F: Friability (%w/w); W: Weight variation (%w/w); D.T.: Disintegration time (minute); S: Syrup; T: Tincture; Ta: Tablet; C: Color; O: Odor; Ts: Taste; Sp.: Specific gravity at room temperature [g/ml]; R: Refractive index at room temperature; V: Viscosity (milliPoise); Tu: Turbidity; H: Homogeneity; Ha: Hardness (Kg/inch square); F: Friability (%w/w); W: Weight variation (%w/w); D.T.: Disintegration time (minute); S: Syrup; T: Tincture; Ta: Tablet;

72 hrs. Hence, shelf life and all other related issue of Kvatha may be solve by converting Kvatha into most convenient dosage formed as per requirement.

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