

inhibitory concentration.

Optimized formulation F2 was tested for stability at 0-8° (refrigerator), ambient temperature (R.T.) and 45±2° at 75%±5% R.H. for the span of three months. No significant changes were observed in the characteristics of F2 except slight changes in viscosity without sign of clogging (Table 2). Hence, it was concluded that HSG containing 1% of ketoconazole with Carbopol 940 base could be used as an effective cosmeceutical in the treatment of dandruff since it can prolong contact time and impart style to hair.

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## Taste Masking of Quinine Sulphate

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**Quinine sulphate, an antimalarial agent, is extremely bitter in taste. The present communication deals with development of taste-masked resinates of quinine sulphate using ion exchange resins. The drug resin complexation procedure was optimized with respect to parameters like drug to resin ratio, volume of medium and taste of the complex. The taste-masked complex was then formulated into a prototype suspension base. The suspension was evaluated for various quality control parameters. Taste evaluation of the suspension showed complete masking of the bitterness of the drug. *In vitro* release studies revealed complete drug elution from the complex after a period of 30 min in pH 1.2 buffer.**

Ion exchange resins are water insoluble, cross-linked polymers containing salt forming groups in repeating positions on the polymer chains. They are used in many industries including pharmaceutical industry to stabilize sensitive compounds<sup>1</sup>, as tablet disintegrants<sup>2</sup>, for sustaining the release of the drug<sup>3</sup> and most importantly taste masking<sup>4</sup>. The ion exchange resin complexes with the drug through weak ionic bonding. Drug release from the resin depends

on pH and electrolyte concentration within the gastrointestinal tract<sup>5</sup>.

The present research work was focused on taste masking of quinine sulphate, having bitterness threshold of 0.0007% indicating its intense bitter taste. Chemically, quinine sulphate is (8R,9S)-6-methoxyl cinchonan-9-ol sulphate dihydrate and it possesses antimalarial activity. The therapy of malaria lasts for 7 d. Formulation of palatable liquid dosage forms especially for pediatric and geriatric patients, who cannot swallow solid dosage forms, becomes a necessity.

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Quinine sulphate being water-soluble poses a greater challenge for a formulation scientist since the focus shifts to avoiding leaching during the entire shelf life in addition to formulating a palatable product.

Indion 254 with cross linked polystyrene matrix and having SO<sub>3</sub>Na functional group and Indion 234-cation exchange resin with cross-linked acrylic co-polymer matrix and having free carboxylic acid active group in potassium form were obtained as gift sample from Ion Exchange India Ltd, Mumbai. Quinine sulphate was obtained from Ipca Laboratories, Mumbai. All solvents and reagents used were of analytical grade.

Indion 254 and Indion 234 are non-toxic and safe for human consumption. The oral LD<sub>50</sub> value of these resins is about 10,000 mg/kg indicating their suitability for oral route of administration. Taste-masked complexes of quinine sulphate were prepared by magnetic stirring method<sup>6</sup> using glass-distilled water as the medium. Drug and resin were mixed in various ratios 1:1 to 1:5 on weight basis and stirred on a magnetic stirrer for a period of 1 to 5 h using different

volumes of glass-distilled water as the medium. Non-bitter complex was yielded at 1:5 drug to resin ratio using 400 ml of water when stirred for 5 h. The complex was vacuum filtered and then dried at 40° for an hour. The taste-masked complex was incorporated into a prototype aqueous suspension base using various additives like sweeteners, viscosity modifying agents and flavors. The suspension was evaluated for various quality control parameters that included appearance, taste, pH rheological behavior, particle size distribution, drug content and drug release. Taste of the suspension was evaluated by a panel of 10 healthy human volunteers. pH was recorded on a Systronics pH meter. Rheological behavior was studied using a Brookfields viscometer (model RVT) with Ultra low viscosity adapter. Particle size was determined using optical microscopy. Drug content of the suspension was estimated by eluting the drug in 0.1 N HCl, filtering and measuring drug content spectrophotometrically at 330 nm. *In vitro* drug release was determined using USP dissolution rate test apparatus II i.e. paddle type, in 500 ml of pH 1.2 buffer (0.1 N HCl) and pH 6.7 buffer at a speed of 100 rpm. Aliquots were withdrawn at suitable time

TABLE 1: TASTE EVALUATION OF QUININE SULPHATE SUSPENSION USING INDION 254.

Volunteer Parameter	1	2	3	4	5	6	7	8	9	10
Bitterness	-	-	-	-	-	-	-	-	-	-
Sweetness	+++	+++	++	+++	+++	+++	+++	+++	+++	++
Aftertaste	-	+	+	-	+	++	-	-	-	-
Flavor	++	+++	+++	++	++	+++	+++	+++	++++	+++
Mouthfeel	+++	+++	+++	++	++	+++	+++	++	++	++

Volunteers 1 to 10 asked to grade the suspension. Bitterness and aftertaste were graded from non bitter (-) to less bitter (+) to bitter (++) to very bitter (+++). Sweetness was graded from less sweet (+) to sweet (++) to very sweet (+++). Flavor and mouthfeel were assessed from less (+) to moderate (++) to good (+++).

TABLE 2: TASTE EVALUATION OF QUININE SULPHATE SUSPENSION USING INDION 234.

Volunteer Parameter	1	2	3	4	5	6	7	8	9	10
Bitterness	-	-	-	-	-	-	-	-	-	-
Sweetness	+++	+++	+++	+++	+++	+++	+++	+++	+++	+++
Aftertaste	-	+	+	-	++	++	-	-	-	-
Flavor	++	+++	+++	++	++	++	+++	+++	+++	+++
Mouthfeel	+++	+++	+++	+++	+++	+++	+++	++	++	++

Volunteers 1 to 10 asked to grade the suspension. Bitterness and aftertaste were graded from non bitter (-) to less bitter (+) to bitter (++) to very bitter (+++). Sweetness was graded from less sweet (+) to sweet (++) to very sweet (+++). Flavor and mouthfeel were assessed from less (+) to moderate (++) to good (+++).

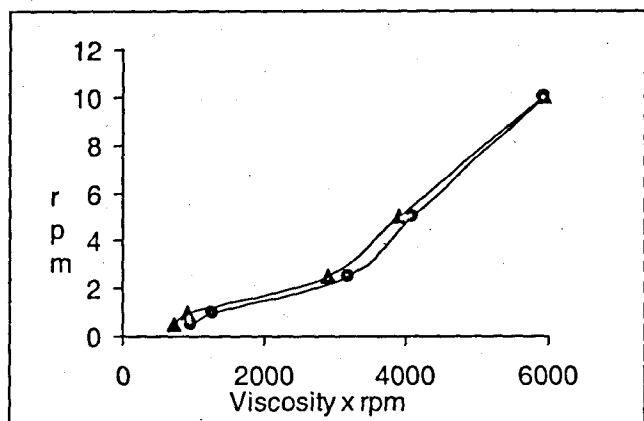


Fig. 1: Rheological behavior of quinine sulphate suspension containing Indion 234.

Upcurve is indicated by (▲) and Downcurve is indicated by (●)

intervals and analyzed using UV spectroscopy at 330 nm.

With regard to appearance, visual inspection indicated that the suspension had a cream color. For taste evaluation, volunteers were administered 1 ml of suspension perorally and asked to grade the suspension. Bitterness and after-taste were graded from non bitter (-) to less bitter (+) to bitter (++) to very bitter (+++). Sweetness was graded from less sweet (+) to sweet (++) to very sweet (+++). Flavor and mouthfeel were assessed from less (+) to moderate (++) to good (+++).

The results of the taste evaluation of the suspensions are shown in Tables 1 and 2. All 10 volunteers perceived the suspensions non-bitter. Though the suspensions had a slightly bitter after taste, they were well tolerated due to the presence of sweeteners and flavors. Both suspensions had a non-gritty mouthfeel and also a good flavor.

It was observed that both the suspensions had a pH of 4-5 and exhibited pseudoplastic behavior with thixotropy (fig. 1) with an average particle size of 65-75  $\mu\text{m}$ . The drug Indion 254 complex failed to break in 0.1 N HCl. The drug content in the formulation containing Indion 234 was within limits ( $99.7 \pm 1.97\%$ ). Also, as shown in fig 2, dissolution studies of the suspension containing Indion 234 showed more than

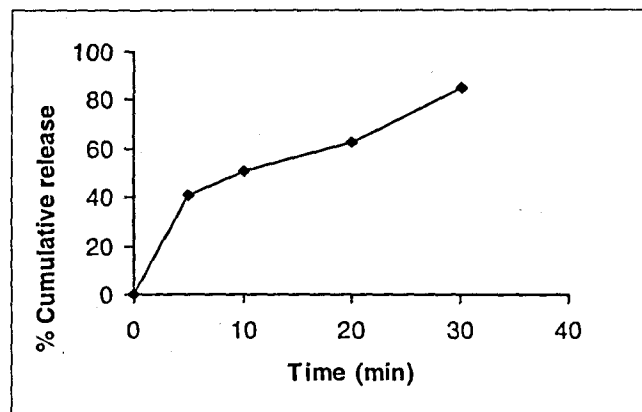


Fig. 2: Release profile of quinine sulphate suspension containing Indion 234 in pH 1.2 buffer.

(◆) indicates percentage cumulative release at different time intervals.

80 % release of the drug within 30 min. *In vitro* release testing in pH 6.7 using same parameters indicated no release implying that drug resin complex will not break at salivary pH, thus retaining palatability of the suspension.

Thus the process for preparing drug resins was optimized with respect to parameters like drug and resin ratio, volume of medium and taste of the complex. Ratio of 1: 5 of drug to Indion 234 gave a complete taste masked complex, which could be easily incorporated in a prototype suspension formulation to give a palatable product. Indion 234 was found to be superior in formulating taste masked suspension of quinine sulphate.

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