

Research Article

## Evaluation of KYRON T-314 (Polacrillin Potassium) as a novel super disintegrant

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### Abstract

Orodispersible tablets (ODTs), also known as fast melt, quick melts, fast disintegrating have the unique property of disintegrating in the mouth in seconds without chewing and the need of water. The purpose of this investigation was to develop mouth dissolving tablets of aceclofenac using KYRON T-314 (Polacrillin Potassium) as a novel superdisintegrant. Mouth dissolving tablets of aceclofenac were prepared by wet granulation technique using KYRON T-314 as superdisintegrant and menthol as subliming agent. The present study demonstrated potentials for rapid absorption, improved bioavailability, effective therapy and patient compliance.

**Keywords:** KYRON T-314, Mouth dissolving tablet, Aceclofenac, Subliming agent, Superdisintegrant.

### Introduction

The tablet is the most widely used dosage form because of its convenience in terms of self-administration, compactness and ease in manufacturing. However, geriatric and paediatric patients experience difficulty in swallowing conventional tablets, which leads to poor patient compliance. To overcome this weakness, scientists have developed innovative drug delivery systems known as mouth dissolving tablets. Their characteristic advantages such as administration without water, anywhere, anytime lead to their suitability to geriatric and paediatric patients. They are also suitable for the mentally ill, the bedridden and patients who do not have easy access to water. The benefits, in terms of patient compliance, rapid onset of action, increased bioavailability and good stability made these tablets popular as a dosage form in the current market [1-2].

NSAID has been indicated for various painful indications [3] and proved as effective as other NSAIDs with lower indications of gastrointestinal adverse effects and thus, resulted in a greater compliance with treatment [4]. Aceclofenac, (2-[2-[2-(2,6 dichlorophenyl) aminophenyl] acetyl] oxyacetic acid), a nonsteroidal anti-inflammatory, analgesic and antipyretic drug used in rheumatoid arthritis, post-traumatic pain, musculo-skeletal and joint disorders [5].

Aceclofenac is practically insoluble. For poorly soluble orally administered drugs, the rate of absorption is often controlled by the rate of dissolution. The rate of dissolution can be increased by increasing the surface area of available drug by various methods (micronization, complexation and solid dispersion). The dissolution of a drug can also be

influenced by disintegration time of the tablets. Faster disintegration of tablets delivers a fine suspension of drug particles resulting in a higher surface area and faster dissolution. Polacrillin Potassium (KYRON T-314) is 2-methyl-2-propenoic acid polymer with divinylbenzene, potassium salt. It is a cation exchange resin used in oral pharmaceutical formulation as a tablet superdisintegrant. It appears as a cream colored, odorless and tasteless, free flowing powder [6].

In the present study, an attempt has been made to develop mouth dissolving tablets of aceclofenac using novel superdisintegrant and to investigate the effect of subliming agent on the release profile of the drug. The fundamental principle used in the development of the fast-dissolving tablet is to maximize its pore structure. Researchers have evaluated spray dried materials [7] and plastic materials [8] for development of such tablets. Vacuum-drying [9-14] and freeze-drying [15-18] techniques have been also tried by researchers to maximize the pore structure of the

matrix will easily pick up the disintegrating medium and break quickly.

## Material and Methods

### Materials

Aceclofenac and KYRON T-314 were obtained as a gift sample from Blue Cross Lab. Ltd, Nasik, India. Menthol, Magnesium stearate, Aspartame and Mannitol were purchased from local authorized dealer.

### Method

#### Formulation of mouth dissolving tablets of aceclofenac

The orodispersible tablets of aceclofenac were prepared using the subliming agent, menthol and KYRON T-314 as superdisintegrant, mannitol as diluent, aspartame as sweetening agent, alcoholic solution of polyvinyl pyrrolidone (PVP K-30) (10 %w/v) as binder and magnesium stearate with talc as flow promoter. The composition of each batch is shown in Table 1.

**Table 1:** Composition of different batches of mouth-dissolving tablets of aceclofenac.

Name of Ingredients	Quantities (mg)				
	F1	F2	F3	F4	F5
<b>Aceclofenac</b>	<b>100</b>	<b>100</b>	<b>100</b>	<b>100</b>	<b>100</b>
<b>Menthol</b>	<b>20</b>	<b>20</b>	<b>25</b>	<b>25</b>	<b>25</b>
<b>Kyron T-314</b>	<b>20</b>	<b>20</b>	<b>20</b>	<b>25</b>	<b>25</b>
<b>Magnesium stearate</b>	<b>5</b>	<b>5</b>	<b>5</b>	<b>5</b>	<b>5</b>
<b>Mannitol</b>	<b>55</b>	<b>50</b>	<b>45</b>	<b>40</b>	<b>40</b>
<b>Total</b>	<b>200</b>	<b>200</b>	<b>200</b>	<b>200</b>	<b>200</b>

\*all the quantities expressed in mg. All batches contained 10% (PVP K-30) in ethyl alcohol as a binder and 2% talc and 1% magnesium stearate. Menthol was sublimed from granules in Batches F1 to F4 and from tablets in Batch F5.

tablet matrix. Freeze drying is cumbersome and yields a fragile and hygroscopic product. Therefore, a vacuum drying technique was adopted in the present investigation after addition of a subliming agent to increase porosity of the tablets. It is likely that a porous hydrophilic

The raw materials were passed through a 100-mesh screen prior to mixing. The drug and other ingredients were mixed together and a sufficient quantity of alcoholic solution of PVP K-30 (10%w/v) was added and mixed to form a coherent mass. The wet mass was granulated using sieve no. 12 and regranulated after drying

through sieve no. 16. Granules of the all formulations were then dried in a vacuum oven (Vertex, VT4810) at 60 °C for 12 h resulting in localized drying. The final moisture content of the granules was found to be between 1-2%, which was determined using an IR moisture balance. During drying, the menthol sublimed with the formation of a porous structure on the surface of the tablet. The dried granules were then blended with talc, magnesium stearate and compressed into tablets using flat face round tooling on a Rimek-I rotary tablet machine (Karnavati Engg. Pvt. Ltd, Ahmedabad). Sublimation was performed from tablets instead of granules at 60 °C in selected batch (F5).

#### Evaluation of formulated tablets:

##### Thickness

Thickness of tablet was determined by using vernier calliper (Mitutoya, Model CD-6 CS,

Japan).

##### Hardness [19]

The crushing strength of the tablets was measured using a Monsanto hardness tester (Sheetal Scientific Industries, Mumbai, India). Three tablets from each formulation batch were tested randomly and the average reading noted.

##### Friability [19]

Ten tablets were weighed and placed in a Roche friabilator (Electrolab, India). Twenty preweighed tablets were rotated at 25 rpm for 4 min. The tablets were then dedusted and reweighed and the percentage of weight loss was calculated. The percentage friability of the tablets were measured as per the following formula,

$$\text{Percentage friability} = \frac{\text{Initial weight} - \text{Final weight}}{\text{Initial weight}} \times 100$$

##### Weight Variation

Randomly, twenty tablets were selected after compression and the mean weight was

**Table 2:** Evaluation of mouth-dissolving tablets of aceclofenac.

Parameters	F1	F2	F3	F4	F5
Hardness (kg/cm <sup>2</sup> )	3.1±0.30	3.4±0.68	2.9±0.51	3.1±0.63	3.6±0.10
Friability (%)	0.743±0.04	0.629±0.06	0.637±0.05	0.688±0.04	0.574±0.04
Weight variation (mg)	204±3	199±2	203±3	197±1	200±1
Thickness (mm)	3.5±0.03	3.4±0.07	3.6±0.05	3.4±0.06	3.5±0.01
Wetting time (s)	38.2±2.5	39.3±1.5	43.6±2.2	39.1±2.0	29.4±1.5
<i>In vitro</i> dispersion time (s)	68.3±2	62.1±1	56.2±2	53.7±3	41.8±2
Drug content	99.24±3.24	98.44±2.54	98.60±3.04	98.93±1.81	99.42±1.27
Drug release in 5min (%)	69.03±2	72.17±2	73.72±2.5	75.54±3	78.37±1.5
Drug release in 30min (%)	86.81±1.2	88.11±1.6	88.73±2.5	93.26±2.7	97.25±1.3

determined. None of the tablets deviated from the average weight by more than  $\pm 7.5\%$  (USPXX).

#### **Drug content**

Twenty tablets were weighed and powdered. An amount of the powder equivalent to 100mg of aceclofenac was dissolved in 100 ml of pH 7.4 phosphate buffer, filtered, diluted suitably and analyzed for drug content at 274 nm using UV-Visible Spectrophotometer (UV 160- Shimadzu, Japan).

#### **Wetting time [20]**

A piece of circular tissue paper (8cm) folded twice was placed in a Petri dish (Internal Diameter = 9cm) containing 10 ml of buffer solution simulating saliva pH 6.8. A tablet was placed on the paper and the time taken for complete wetting was noted. Three tablets from each formulation were randomly selected and the average wetting time was noted. The results are tabulated in Table 2.

#### ***In vitro* dispersion time [21]**

*In vitro* dispersion time of prepared tablet was done by dropping the tablet in 10 ml measuring cylinder containing 6 ml of simulated salivary fluid (pH 6.8). Time required for complete dispersion of tablet was measured.

#### **Dissolution Study**

*In vitro* release of aceclofenac from tablets was monitored by using 900 ml of simulated intestinal fluid, SIF (USP phosphate buffer solution, pH 7.4) at  $37 \pm 0.5$  °C and 50 rpm using programmable dissolution tester [Paddle type, model TDT-08L, Electrolab, (USP), India]. 5 ml Aliquots were withdrawn at one minute time intervals and were replenished immediately with the same volume of fresh buffer medium. Aliquots, following suitable dilutions, were assayed spectrophotometrically (UV-1700, Shimadzu, Japan) at 274 nm.

#### **Results and Discussion:**

Mouth dissolving drug delivery is rapidly gaining acceptance as an important drug delivery technology. In such drug delivery, different dosage forms disintegrate rapidly in the patient's mouth within a minute and can be gulped easily

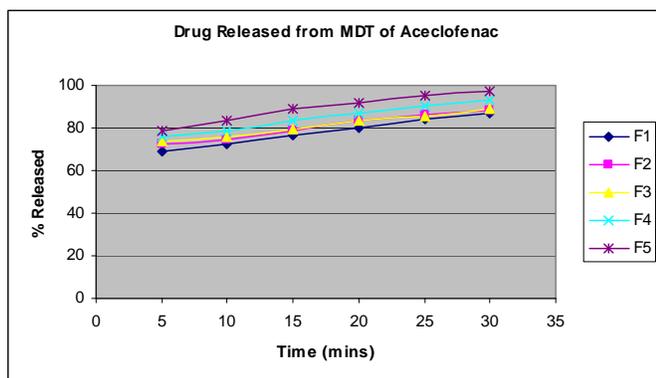
without need of water. This rapid disintegration can be achieved by use of high levels of disintegrant and/or effervescent agents along with water soluble diluents. Hence, it offers increased patient compliance and convenience. Water insoluble diluents such as microcrystalline cellulose and dicalcium phosphate were omitted from the study as they are expected to cause an unacceptable feeling of grittiness in the mouth. Among the soluble diluents, mannitol was selected as a diluent considering its advantages in terms of easy availability and negative heat of dissolution.

Table 2 shows that all the formulated tablets exhibited low weight variation. Addition of a subliming agent had no pronounced effect on hardness and increased friability of the tablets. The wetting time, *in vitro* dispersion time of the tablets were also considerably reduced in tablets (Table 2). The drug content of all the formulations was found to be between 98.4-99.5% which was within the acceptable limits as per USP XXVII. The porous structure is responsible for faster water uptake; hence it facilitates wicking action of KYRON T-314 in bringing about faster disintegration. Tablets with lower friability may not break during handling on machines and/or shipping. The use of a sublimation agent resulted in increased friability probably due to increased porosity. In the first few attempts (F1-F4), sublimation of menthol was performed from granules prior to compression into tablets. Batches F1 to F4 showed good mechanical integrity, but the disintegration time was a little longer than the arbitrarily chosen value of less than 50 seconds. In Batch F5, sublimation was performed after compression rather than directly from granules. The results shown in Table 2 reveal that sublimation of menthol from tablets resulted in faster disintegration. The compaction process might have caused breakage of porous granules and subsequent reduction in porosity. The low value of wetting time and disintegration time indicate that the porosity of tablets of batch F5 would be greater than batches F1 to F4.

*In vitro* release studies were carried out using USP XXIII tablet dissolution test apparatus paddle method at  $37 \pm 1^\circ\text{C}$ , taking 900 ml of simulated intestinal fluid (SIF) as dissolution medium. Speed of rotation of the paddle was set at 50 rpm. Aliquots of 5 ml were withdrawn after 1, 3, 5, 6, 8, 10, 30 min and analyzed spectrophotometrically at 274 nm. The *in vitro* dissolution profile (Fig.1) indicated faster and maximum drug release from formulation F5.

Formulation F5 prepared by direct sublimation of menthol from final tablets showed 78.37% drug release at the end of 5 min when compared to tablets prepared by sublimation of menthol from granules. The rapid drug dissolution might be due to easy breakdown of particles due to porous structure formation after sublimation of menthol and rapid absorption of drugs into the dissolution medium.

**Fig. 1:** In vitro release profile of various Aceclofenac formulations.



### Conclusion:

Polacrillin Potassium (KYRON T-314) is a cation exchange resin used in oral pharmaceutical formulation it swell rapidly when wetted. In the present study we used it as a novel super disintegrant and studied the effect of the effect of subliming agent on the release profile of the drug. From the outcome of this study, it can be concluded that sublimation method showed better disintegration and drug release. The prepared tablets using KYRON T-314 disintegrate within few seconds without need of water; thereby enhancing the absorption leading to its increased

bioavailability. Vacuum-drying technique would be an effective alternative approach compared with the use of more expensive adjuvants in the formulation of mouth dissolving tablets.

### Declaration of interest:

The authors report no conflicts of interest.

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