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Ingestion risk assessment: Gellibaff (Glibbi Slime) and Snoball

1. Purpose of assessment

The client requested PSC Ltd to assess the potential risks related to the ingestion of Gellibaff, and Snoball, particularly in regard to bowel obstruction or irritation of the intestinal mucosa. These products are essentially powders made from super absorbent polymers. A key characteristic of these polymers is that they absorb many times their own weight in water with a consequent increase in physical size. There are case reports in the literature describing paediatric bowel obstruction following ingestion of polymer balls, but not powders.

2. Nature of product and intended use

Both products are supplied in powder form. The Gellibaff product is intended to be mixed with water prior to bathing to form a slippery gel. The product will be used by children but typically under adult supervision. The Snoball product is intended to be mixed with water to form artificial 'snow' that can be used in play. In this case, the product is more likely to be used without adult supervision.

3. Characteristics of super absorbent polymers

Super absorbent polymers are typically polyacrylates. These form hydrogels and increase in size as they absorb water. The degree of swelling is pH dependent (Elyashevich et al. 2009) with maximal volume attained at neutral pH (~6) and minimal volume at low and high pH. With the exception of gastric fluid, the pH at which maximal swelling occurs is also the approximate physiological pH. The degree of swelling is also dependent on the concentration of sodium ions. An excess of sodium ions reduces the amount of swelling.

4. Specific investigations

The expansion of polymer balls in various fluids is described in the literature (Darracq et al. 2015), but there is a lack of data for polymer powders. Since the risk from ingestion of the product is dependent on the expansion characteristics in various body fluids such as saliva, stomach acid and intestinal fluid, specific investigations were carried out to provide data as the basis for the risk assessment.

Simulated body fluids were prepared as follows:

Simulated saliva	Sodium chloride, citric acid, sodium bicarbonate and phosphate buffer in distilled water (pH 6.45)
Simulated gastric fluid	Hydrochloric acid, sodium chloride in distilled water (pH 1.2)
Simulated intestinal fluid	Phosphate buffer and sodium hydroxide in distilled water (pH 6.0).

Approximately 100mg of the dry polymer powder was placed in four sample tubes. A 10ml aliquot of each of the simulated fluids was added to three tubes, and 10ml of distilled water was added to the fourth tube. The swelling of the polymer powder was observed over time in each case.

The results are summarised below.

Distilled water: Both Gellibaff and Snoball gelled almost immediately to form a semi-solid clumped mass.

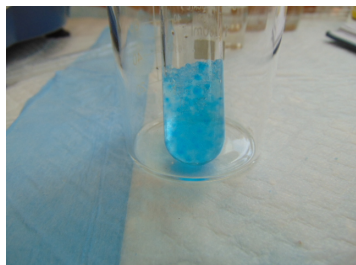
Simulated saliva: Gel formation was less rapid than in distilled water for both powders. After five minutes, the polymer particles had swelled to some degree and formed a viscous liquid gel. After 10



minutes there was no observable change in the characteristics of the liquid and significant clumping was not apparent.

Simulated gastric fluid: Gel formation was minimal and although some swelling did occur this was not as pronounced as the samples in simulated saliva.

Simulated intestinal fluid: The rate of gel formation was similar to that in simulated saliva. After five minutes, the polymer particles had swelled to some degree and formed a viscous liquid gel. After 10 minutes there was no observable change in the characteristics of the liquid and significant clumping was also not apparent. The samples were further observed after 1, 2 and 3 hours. There was minimal change in the observed physical nature of the gels except for Snoball which exhibited a greater degree of clumping. In both cases however, the gel formed was of limited cohesion and was able to be broken up by stirring with a glass rod.



Gellibaff in simulated intestinal fluid

5. Discussion

The results obtained in the investigation are generally consistent with those in the literature. Polymer swelling was minimal in gastric fluid, presumably due to the low pH of the aqueous medium. Swelling of the powder and gel formation was greatest in distilled water. Although swelling did occur in both saliva and intestinal fluid, the degree of gel formation was reduced and the rate at which it was formed was slower when compared to distilled water. This is likely to be due to presence of sodium and potassium cations which have been shown to inhibit gel formation. The behaviour of water absorbing

powders is however different than that observed when water absorbing beads are placed in water. The latter can rapidly grow to significant sizes leading to bowel obstruction.

6. Risk assessment

Although swelling of the polymer powder did occur in simulated body fluids, the rate of expansion and degree of clumping was lower than that seen in distilled water. The powder is considered unpalatable and is also unlikely to be confused with a food item. If taken into the mouth it is unlikely that the child will swallow significant amounts due to the nature of the material. Based on the above investigations, if the powder is swallowed however, it is unlikely to form a mass that would cause intestinal blockage. In all cases, the polymer formed a loose viscous gel that was easily broken up by mechanical action. Irritation of the intestinal mucosa is possible, but serious effects are considered unlikely based on the eye irritation potential of sodium polyacrylate.

Ingestion of material that has already absorbed water is considered to be of low risk since expansion has already occurred and although semi-solid is unlikely to result in obstruction. Gel formation is however an equilibrium process and is generally reversible. Exposure to body fluids would result in a reversal of the gelling process.

It is reasonable therefore to conclude that unintentional ingestion of Gellibaff and Snoball is unlikely to result in blockage of the gastro-intestinal tract in the majority of cases unless a significant quantity of powder is ingested. This scenario is however considered to have a very low probability of occurrence based on the nature of the powder. The risks of Gellibaff and Snoball should not be considered to be the same as those related to water absorbing beads.

The product is considered to be safe under conditions of normal and foreseeable use. It is recommended however that if contacted by parents or carers that are concerned that their child has swallowed some powder the consumer should be advised to obtain medical advice without delay.



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References

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