Developments in the manufacture and preservation of sandesh: A review

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ABSTRACT
Sandesh represents the traditional Indian dairy product used as sweet dairy desserts, prepared by acid and heat coagulation of milk. It is popular throughout eastern part of India especially in West Bengal. It is a rich source of high quality animal protein, fat, minerals and vitamins. It is appreciated by people belonging to all age groups and social levels. Due to availability of different types of milk and variation in milk composition, various techniques have been developed for the production of sandesh as per the requirements of the consumers with attendant improvement in the yield and other quality characteristics. The aim of the present review paper is to update the production methods of sandesh, moisture sorption isotherms, textural properties and value addition to sandesh.

Key words: Coagulation, Moisture sorption isotherm, Sandesh, Value addition.

Sandesh is one of the heat-acid coagulated milk product available in India. It is a sweet product mostly produced in unorganized small-scale sectors wherein variations in quality between batches, days of production and shops are noticed (Yadav et al., 1989; Patil, 2005). FSSAI (2011) has so far not laid down any standards for sandesh. The cost of raw materials for sandesh preparation is about 40% of the sale price, which makes it a profitable product (Parekh, 1994). Sandesh is popular due to its palatability and aroma. It is a rich source of milk protein, fat, carbohydrate and vitamins like A and D.

Chhana, a heat-acid coagulated product of milk forms the base material for the preparation of sandesh. In the preparation of sandesh, milk is heated to 90-95°C, followed by cooling to 70°C. A coagulating agent such as citric acid, calcium lactate (as solution), lemon juice or sour whey, previously heated to 70°C is added to the heated milk to precipitate the milk. The precipitation of milk involves the formation of large structural aggregates of whey protein in which milk fat, other colloidal and soluble solids such as carbohydrate, calcium, phosphate, vitamins, nitrogenous materials (ammonia, amino acid, urea, creatine, etc.), entrained with whey. The whey is drained out through a muslin cloth. The partly dewatered product, called chhana, is kneaded into a uniform dough, mixed with sugar and cooked over low flame with constant scraping until the mixture gets the desired consistency and flavor.

Sandesh of many varieties is manufactured and sold in the country. Such varieties differ in appearance, flavor, color, body, texture, and composition. Generally the three main types of sandesh includes Narampak (soft grade and medium moisture), Karapak (Hard grade and medium moisture) and Kachhagolla (very soft and high moisture). Among these, Narampak is the most popular variety. It has yellowish white to pale yellow color, a sweet, pleasant, slightly cooked, caramelized flavor with soft and cohesive body, smooth texture with small size grains (Sen and Rajorhia, 1985; Sen and Rajorhia, 1991). They are differentiated by their distinct physical qualities and chemical composition. Hard grade sandesh contains smaller proportion of moisture, fat and protein, but higher amount of sucrose than soft grade sandesh (Sarkar, 1975).

Sandesh has an excellent market potential and higher profit margin compared with other milk products like table butter, cheese and milk powder. Although Indian dairy industry has made rapid strides in the last few decades, there is no systematic packaging system, developed so far, for storage of sandesh. Keeping pace with the growing consumer’s demand for fresh, convenient and microbiologically safe foods design of proper packaging system is the need of the hour. Aneja et al. (2002) has mentioned that about 80% of chhana produced in Kolkata (West Bengal, India) is converted into sandesh. Spices (clove, small cardamom, large cardamom, saffron, etc.) have been used as flavouring and also as colouring agent in sandesh.

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preparation for centuries. It has been estimated that the annual production of sandesh in West Bengal alone is 30,000 tons (Bandyopadhyay and Khamrui, 2007). The chemical composition of the sandesh samples is presented in Table 1. The moisture content was raised in sandesh made from low fat milks (i.e., from toned milk and double toned milk) in order to prevent the product from having dry appearance and hard body and texture.

**Raw materials for Sandesh:** Chhana forms the base material for the preparation of sandesh.

**Type of chhana**

**Cow milk chhana:** Cow milk chhana is usually preferred for sandesh making because of its soft body, smooth texture and small grains. Generally standardized cow’s milk with 4% fat and 8.5% solid-not-fat has been used in the preparation of chhana. (De, 1980) reported the fat content of milk has to be regulated. A minimum fat content of 4% in cow milk and 5% in buffalo milk was essential for satisfactory quality of chhana. Sen and De (1984). Reported that satisfactory quality of chhana can be made from calcium lactate for sandesh preparation.

Cow milk is preferred to buffalo milk for the production of sandesh due to the unique chemical composition of cow milk. Buffalo milk on the other hand tends to produce a hard body and coarse texture in sandesh due to higher concentration of protein and minerals. Since buffaloes contribute to more than 50% of country’s total milk production, it was necessary to develop a modified procedure for producing acceptable quality sandesh from buffalo milk. Suitable modifications in the manufacturing procedure and use of additives might help to improve the quality of sandesh from buffalo milk through regulation of proportions and state of the major constituents in the product namely water, protein and fat. Carrageenan, sodium alginate and carboxymethyl cellulose (CMC) are normally used as thickeners and emulsifiers in many dairy products and other processed foods to improve water binding and fat retention capacity (Wallingford and Labuza 1983). An attempt was, therefore, made to develop a standardized procedure for the manufacture of sandesh from buffalo milk to provide avenues for utilization of buffalo milk in the production of sandesh and other chhana-based sweetmeats, maintain uniformity in product quality, pave the way for mechanization of manufacturing process and help in the formulation of legal standards for sandesh.

**Buffalo milk chhana:** Buffalo milk chhana leads to a product with hard body and coarse texture, both being undesirable characteristics. However, successful attempts were made in developing methods for the production of Narampak sandesh using buffalo milk by Sen and Rajorhia (1991). It involved standardization of buffalo milk to 4.0% fat, heating to boil, dilution with water (30% of milk volume) followed by coagulation to obtain chhana, which was converted into smooth paste and divided into two lots. Ground sugar at the rate of 30% by weight of chhana was mixed with one lot of chhana and then slowly cooked at 75°C with continuous stirring and scraping. On reaching patting stage, the second lot of chhana was added to it and blended. Heating and scraping was continued till a final temperature of 60°C was reached. The mix was then cooled to 37°C and moulded in desired shape and size and packaged in suitable packages.

**Recombined milk for chhana:** Cow skim milk powder and butter oil were used as SNF and fat sources respectively for preparing recombined milk (RCM). Such RCM was blended with cow milk in various proportions (i.e. 25:75; 50:50, 75:25 and 100:0 of RCM: cow milk, w/w) to be made into chhana. Such blended milk was heated to 80°C and coagulated using 2 per cent citric acid solution. The coagulum was transferred to a muslin cloth and hung for whey drainage to obtain chhana.

**Recent developments in sandesh production**

**Herbal sandesh:** Antioxidants are chemical substances that reduce or prevent oxidation and have the ability to counteract

### TABLE 1: Chemical composition of Sandesh prepared from different classes of milk

<table>
<thead>
<tr>
<th>Type of milk</th>
<th>Moisture (%)</th>
<th>Fat (%)</th>
<th>Protein (%)</th>
<th>Total carbohydrates (%)</th>
<th>Ash (%)</th>
<th>References</th>
</tr>
</thead>
<tbody>
<tr>
<td>Buffalo milk</td>
<td>27.0</td>
<td>21.9</td>
<td>12.4</td>
<td>37.1</td>
<td>1.6</td>
<td>Sanyal et al. (2011)</td>
</tr>
<tr>
<td>Buffalo milk</td>
<td>27.1</td>
<td>18.5</td>
<td>19.8</td>
<td>33.8*</td>
<td>1.9</td>
<td>Sen and Rajorhia (1991)</td>
</tr>
<tr>
<td>Buffalo milk</td>
<td>27.1</td>
<td>18.4</td>
<td>18.7</td>
<td>33.8</td>
<td>1.9</td>
<td>Verma (1997)</td>
</tr>
<tr>
<td>Cow milk</td>
<td>25.5</td>
<td>19.9</td>
<td>18.5</td>
<td>34.5*</td>
<td>1.7</td>
<td>Sen and Rajorhia (1990)</td>
</tr>
<tr>
<td>Cow milk</td>
<td>25.5</td>
<td>19.8</td>
<td>18.4</td>
<td>34.4</td>
<td>1.6</td>
<td>Verma (1997)</td>
</tr>
<tr>
<td>Full cream milk</td>
<td>16.3</td>
<td>29.8</td>
<td>18.6</td>
<td>32.8</td>
<td>1.6</td>
<td>Khamrui and Solanki (2010)</td>
</tr>
<tr>
<td>Standardized milk</td>
<td>17.2</td>
<td>25.7</td>
<td>18.5</td>
<td>36.0</td>
<td>1.6</td>
<td>Khamrui and Solanki (2010)</td>
</tr>
<tr>
<td>Toned Milk</td>
<td>20.0</td>
<td>22.4</td>
<td>18.8</td>
<td>35.8</td>
<td>1.9</td>
<td>Khamrui and Solanki (2010)</td>
</tr>
<tr>
<td>Double toned milk</td>
<td>21.3</td>
<td>17.3</td>
<td>19.5</td>
<td>38.3</td>
<td>2.5</td>
<td>Khamrui and Solanki (2010)</td>
</tr>
</tbody>
</table>

*includes lactose
the damaging effects of free radicals in tissues and thus believed to protect against cancer, arteriosclerosis, heart disease, etc. The widely used synthetic antioxidants in foods are butylated hydroxyanisole (BHA), tertiary butyl hydroquinone (TBHQ), etc. The possible toxicity of the synthetic antioxidants has been a subject of study for many years (Barlow, 1990). This leads to the interest in searching antioxidants from natural food stuff.

Bandyopadhyay et al. (2008) used natural sources of antioxidant viz. beet (Beta vulgaris), mint (Mentha spicata L.) and ginger (Zingiber officinale L.) sandesh. The effectiveness of above mentioned natural antioxidants were compared as against synthetic antioxidants like TBHQ, BHA and butylated hydroxytoluene (BHT) under thermal treatment in arresting lipid oxidation in sandesh. Amongst the natural antioxidants, ginger had the highest antioxidant activity, which was similar to that of TBHQ and blend of BHA and BHT. Regarding antioxidant activity and lipid oxidation, combination of mint or ginger with beet showed better result as compared to beet alone. Sandesh containing beet, ginger, combination of beet with ginger or mint, or combination of mint with ginger were sensorily more acceptable than control sandesh.

Indian herbs such as turmeric (Curcuma longa L.), coriander (Coriandrum sativum L.), curry leaf (Murraya koenigii L.), spinach (Spinacia oleracea) and aonla (Emblica officinalis) are also good sources of antioxidants. These herbs, when incorporated individually, as a paste, at 10% level into sandesh exerted antioxidative properties in the following order: turmeric > curryleaf > aonla > spinach > coriander leaf. The total antioxidative effectiveness of herbal sandesh were lower than samples containing synthetic antioxidants like TBHQ and BHA: BHT (1:1) at 100 and 200 mg/kg levels. Incorporation of herbs at the level used did not significantly affect the overall sensory acceptability of sandesh (Bandyopadhyay et al., 2007a).

Bandyopadhyay et al. (2007b) assessed the antioxidative activities of beet (Beta vulgaris), mint (Mentha spicata L.) and ginger (Zingiber officinale L.) alone and in combination in Sandesh. Addition of beet or mint alone in sandesh showed lower antioxidant level than the addition of ginger alone. However, combination of beet with ginger showed highest antioxidant level among the natural sources and value was almost equal to TBHQ (200mg kg -1). Besides, the suitable stage and form of addition of these herbs in sandesh were also investigated using the Randox’s antioxidant level evaluating chemical. Among the four forms of herbs such as paste, tray-dried powder, freeze-dried powder and solvent extracted form, addition of solvent extracted form in sandesh showed highest antioxidant level than any other form. Similarly, addition of all these herbs at final stage of sandesh preparation showed highest antioxidant level than their addition at the initial stage of sandesh preparation. Comparative evaluations of the proximate composition of herbal sandesh with the control sandesh showed that herbal sandesh were more or less similar with control sandesh except in fat and moisture content. But according to sensory characteristics, sandesh containing beet, ginger or combination of beet with ginger or mint was more acceptable to panelist than control sandesh. Results of the study indicate that herbal sandesh is more value added health food than control sandesh.

**Dietetic sandesh:** Stevia was added at three levels in the experimental Sandesh while sugar was used in control product. It was found that 25 mg of stevia in experimental Sandesh was acceptable as compared to the control. The experimental sandesh had 67.40 g of moisture, 18.84 g of protein, 1.77g of fat, 8.37g of carbohydrates and provided 125 Kcal of energy per 100 g of product. Sandesh where sucrose has been substituted by low calorie sweeteners like sorbitol (Rai et al., 1999). Honey was used for the preparation of sandesh. Honey is considered as an intermediate moisture food, thus it can lower the microbial load and improve the shelf life of sandesh. Honey in combination with milk provides an excellent nutritional value and is thus recommended as a nutritional source for children (Arora and Parimita, 2014).

**Additives:** Suitable modifications in the manufacturing procedure and use of additives helped to improve upon the quality of sandesh from buffalo milk through regulation of proportion and state of the major constituents in the product namely water, protein and fat. Carrageenan, sodium alginate and carboxy methyl cellulose (CMC) are normally used as thickeners and emulsifiers in many dairy products to improve the water binding and fat retention capacity (Wallingford and Labuz, 1983). Sanyal et al. (2011) developed a standardized procedure for the manufacture of acceptable quality sandesh.

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**TABLE 2: Texture profile of sandesh**

<table>
<thead>
<tr>
<th>Textural attributes</th>
<th>Values</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hardness (g)</td>
<td>3308–14459</td>
</tr>
<tr>
<td>Fracturability (g)</td>
<td>1885–11046</td>
</tr>
<tr>
<td>Resilience</td>
<td>0.014–0.025</td>
</tr>
<tr>
<td>Cohesiveness</td>
<td>0.041–0.069</td>
</tr>
<tr>
<td>Springiness(mm)</td>
<td>0.086–0.301</td>
</tr>
<tr>
<td>Gumminess (g)</td>
<td>188.8–621.7</td>
</tr>
<tr>
<td>Adhesiveness (g.s)</td>
<td>11.6–256.2</td>
</tr>
<tr>
<td>Chewiness (g)</td>
<td>16.2–179</td>
</tr>
</tbody>
</table>

Source: Khamrui and Solanki (2010)
from buffalo milk. Buffalo milk standardized to solids-not-fat (SNF) to fat ratio of 1.4 was added separately with 0.1% (w/w) each of carrageenan, sodium alginate and CMC. The standardized milk containing the additive was then heated, cooled and coagulated to obtain chhana which was subsequently converted to sandesh incorporating 1.5% (w/w) wheat flour and 25% (w/w) cane sugar followed by heating (40 min/kg chhana). Addition of stabilizer decreased the hardness, fracturability, adhesiveness, cohesiveness, gumminess and chewiness of sandesh and improved the sensory body and texture, colour and appearance as well as overall acceptability of the product when compared with control (without stabilizer). Carrageenan (@ 0.1% by weight) proved the best in terms of sensory and texture parameters of the product. Delete last sentence.

**Use of natural colours:** Colour is one of the most important qualities of foods. Colour is an important determinant of acceptance and it enhances the appeal of a food item. Although the use of natural colours in food is an ancient practice, it is currently gaining increasing importance because consumers are wary of the health problems related to the use of synthetic colours. Use of natural colours is seen as an ecologically sustainable, non-hazardous food additive. Many of the sweetmeats made from chhana currently contain artificial colours. The application of a natural colorant such as betalain to sweetmeat products is a new concept in the Indian food industry.

Roy et al. (2004) used natural colorant based on betalain in the manufacture of sandesh at the rate of 0.5 g/15 g of product. The colour intensity of Sandesh remained the same up to 1 week of storage.

**Low calorie sandesh:** Natarajan (2007) developed a low calorie sandesh using skimmed milk as the base. Maltodextrin used at the rate of 5% by weight served as a fat replacer. The sugar was replaced with a low calorie ‘sugarite’ (Sucralose), milk product. To further enhance the therapeutic value of sandesh, bifidus culture was added at the last stage of its preparation. Skimmed milk was incorporated with fat and sugar replacer along with macro, micro nutrient (name the macro and micro nutrients used with their concentration) and converted into a ‘value-added’ sandesh with claimed health benefits. Shelf-life of sandesh at room temperature was just 3 days; fungus growth was observed on 3rd day. In order to prolong the shelf life through prevention of fungus growth in sandesh, chhana used as the base may be treated with sodium benzoate, potassium sorbate or even sodium metabisulphite. Amongst these preservatives, potassium sorbate used at 0.3% was found to be most effective in preventing the growth of fungus up to 10 days of storage at room temperature.

**Mechanized production of sandesh:** Kumar and Das (2003) optimized the processing parameters viz. mixing, kneading and cooking of a mixture of chhana and sugar for the mechanized production of sandesh from cow milk. To overcome the lack of desired homogeneity in product after initial mixing, Kumar and Das (2007) developed a single-screw vented extruder for cooking of mixture of chhana and sugar that paved the way for mechanized continuous production of sandesh. With necessary modifications, this technology may also be adapted to continuous production of sandesh from buffalo milk.

For the coagulation of milk, a continuous heat–acid coagulation unit with a capacity of 60 litre milk/h was used (Sahu et al., 2006). In this unit, the milk was heated to 95±2°C, and citric acid solution of 1.62% strength at 17°C temperature was injected into the heated milk. The moisture content of the chhana attained through such process was 60.0% (w.b.). In order to reduce the moisture content to 48.0% (w.b.) the chhana was subjected to centrifugation using a double-wall basket centrifuge having 0.22 m outside diameter (Pastuer Engg. Co., Pvt. Ltd., Kolkata, India) for 11 min operating at 1,200 rpm. The partly dewheyed chhana (4.5 kg lot) was kneaded into a uniform dough in a jacketed scraped surface agitated vessel for 4.5 min. Cane sugar was incorporated at the rate of 30% of the weight of chhana. The chhana and sugar were mixed and cooked in the vessel at a rotor speed of 70 rpm for 15 min at an absolute steam pressure of 2 kg/cm² (Sahu, 2007). The cooked chhana–sugar mass was allowed to cool to room temperature and then portioned in form of cylinder using a single-screw vertical extruder attached with an intermittently rotating cutting knife (Pastuer Engg. Co., Pvt. Ltd.).

Patil et al. (2005) developed Scraped Surface Heat Exchanger (SSHE) for preparation of sandesh. With regard to the body & texture of sandesh, control (made by conventional method) was superior over the experimental sandesh samples. The body and texture of sandesh was greatly influenced by the loading of chhana-sugar mixture, the speed of the scraper assembly and the initial moisture content of chhana. According to Bandyopadhyay et al. (2007) chhana could be kneaded in a vertical dough mixer to obtain a smooth dough. Total dough was divided into two equal parts and 30% granulated sugar was added on the basis of chhana-dough weight. One part of chhana dough and rest of the sugar was added and kneaded thoroughly in the dough mixer. The blended mixture was heated in a shallow vessel at 75°C for 15 min with continuous stirring. The rest of the chhana dough was then added, and heating resumed to raise the temperature to 60°C within 5 min. Sandesh was removed from the oven.
and moulded into cubes (2 cm) and allowed to cool to room
temperature.

**Storage stability of sandesh**

**Textural Properties of sandesh**: The unique feature of Indian
traditional dairy products is that they are obtained by a wide
variety of methods involving a range of unit operations. This
leads to a great range of product structures and textures. The
chemical components of traditional dairy products including
incorporation of food additives, and the specific processing
conditions would determine the texture and microstructure
of the products. Microstructure in turn, controls some of the
physical properties such as viscosity, firmness, susceptibility
to and elasticity of food products (Prasad, 1998). Retaining
the product’s complex texture, while adopting modified or
new processes, is a real challenge to the manufacturer.
Hence, characterization of a product’s texture is valuable not
only in process development but also in monitoring the
textural quality in routine production. Instrumental textural
data have been correlated with sensory data for several
traditional dairy products (Patel, 2006).

The hardness, fracturability, chewiness and
adhesiveness was found to be highest for sandesh prepared
from milk containing 6% fat and 9% SNF and lowest for sandesh prepared from milk containing 1.5% fat and 9% SNF.
The hardness of sandesh was significantly positively (P < 0.01) correlated with the fat content but negatively correlated
with moisture and ash content. Moisture and fat had negative
and positive correlation (P < 0.01) with fracturability,
respectively. Ash and moisture had a positive (P < 0.01)
influence on resilience whereas fat had a negative influence.
Cohesiveness was not influenced by the composition of sandesh. Springiness had a positive and negative correlation
(P < 0.05) with fat and moisture content, respectively.
Gumminess followed similar pattern for hardness. Moisture
and fat had a negative and positive effect respectively (P < 0.01) on adhesiveness of sandesh. Chewiness was negatively
and positively influenced (P < 0.01) by the moisture and fat
content of sandesh, respectively (Khamrui and Solanki 2010).
Incorporation of carrageenan at 0.1% level produced better
result in terms of textural and sensory profile of sandesh as
compared to 0, 0.075 and 0.125% levels (Sanyal et al., 2011).
Table 2 represents the coefficient of correlation between
composition and textural parameters of sandesh. The textural
parameters of sandesh were significantly influenced by the
fat content of the milk. Most of the textural properties of sandesh were influenced by the moisture, fat and ash content.

**Packaging of sandesh**: The effects of packaging materials
such as paperboard cartons, polystyrene containers, high-
density polyethylene bags, nylon-6 pouches and tin cans, on
the shelf-life of soft-grade buffalo milk sandesh stored at
30±1°C and 70% RH (‘A’ condition) and 7±1°C and 90% RH (‘B’ condition) were studied. At both storage conditions
the maximum chemical, microbiological and organoleptic
deterioration was associated with sandesh samples packaged
in paperboard cartons followed by polystyrene, high-density
polyethylene and nylon-6 packages. Tin cans showed the best
results. At ‘A’ storage condition, sandesh packaged in
paperboard cartons and tin cans became unacceptable on the
6th day with respect to flavor; the extent of deterioration
differed in products packaged in two materials. At ‘B’ storage
condition, sandesh remained acceptable for up to 30 days in
paperboard carton and 45 days in tin cans.

**Moisture sorption isotherm of sandesh**: Water activity is
the most effective method that can help in determining the
storage stability of sandesh. Sorption isotherms describe the
equilibrium relationship between water activity and moisture
content of a food at constant temperature. Moisture sorption
isotherms give an insight into the moisture-binding
characteristic of a food. Hence, knowledge of the moisture
sorption characteristic of a food is important for predicting
the quality, stability and shelf-life during its packaging and
storage (Vilades et al., 1995).

Sahu and Das (2010) determined the moisture
sorption isotherm of sandesh by gravimetical method at 20
and 30°C using various saturated salt solutions in the range
of 11.2 to 97.2%. The isotherms obtained was of sigmoid
shape and Brunauer–Emmett–Teller type. Out of three
sorption models fitted to the experimental data, they found
Caurie’s model is superior in interpreting the moisture
adsorption characteristics of sandesh. The monolayer
moisture content based on the Caurie’s model at 20 and 30°C
was 5.89% and 5.21% (dry basis), respectively. The values
of isosteric heat of sorption as calculated from Clausius–
Clapeyron equation was found to increase with decreasing
moisture content and approached the value of heat of vaporization of free water above 17.25%
(dry basis).

**Marketing and significance of sandesh to indian economy**

India’s market potential and current growth rate of traditional
dairy products is unparalleled and all set to boom further
under the technology of mass production. This market is the
largest in value after liquid milk and is estimated at US $3
billion in India and US $1 billion in North America alone
(Aneja et al. 2002). An estimated 50 to 55% of the milk
produced in India is converted into a variety of traditional
milk products, using processes such as coagulation (heat and/
or acid), desiccation and fermentation (Aneja et al. 2002).
CONCLUSIONS

Sandesh is very popular in eastern parts of India and forms the part and parcel of social life, ceremonies and festivals. Incorporation of functional ingredients like herbs will help to enhance the functional properties of sandesh. Use of intense sweeteners can help in decreasing the calorific value of sandesh, making it attractive to health conscious people. There is an urgent need for formulation and promulgation of standards for sandesh by FSSA. In India, stringent measures should be enforced to ensure strict adherence to hygienic practices during sandesh manufacture at unorganised sector to ensure public health safety. More concerted effort is needed to mechanize the product manufacture and elaborate packaging techniques may help to enhance its shelf life.

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