

# Safety of Fermented Foods

Assessing risks in fermented food processing practices  
and advice on how to mitigate them

- 1 | Introduction to fermented food safety
- 2 | Starter cultures & fermented food standards
- 3 | Fermented food guidance for:

3.1 Vegetables

3.2 Sauerkraut

3.3 Kimchi

3.4 Dosa & Idli

3.5 Fesikh

3.6 Yogurt

3.7 Plant-based cheese

3.8 Natto

3.9 Tempeh

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3.11 Kombucha & Jun

3.12 Kefir

3.13 Sausage

3.14 Pidan Century Egg



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Additional fermented food guidance can be accessed at:

<http://www.bccdc.ca/health-professionals/professional-resources/fermented-foods>

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## Section 3 | Food safety reviews of fermented foods


A national working group of health inspectors, food safety specialists, and industry fermentation experts reviewed this food safety guidance.

Each fermented food review includes:

- background on the food,
- a description of the food preparation,
- a food flow chart,
- a review of the potential issues with the food preparation, and
- food safety control points.

Foods covered in this guidance are sorted in order of increasing complexity and fermenting agent.

**Figure 1 | Fermented foods described by fermentation agent and complexity**

Complexity	Foods	Fermenting Agent	Section
 <p>high</p> <p>low</p>	Sausage	Added LAB <sup>1</sup> , spontaneous moulds & yeasts	3.13
	Kefir, Kombucha	SCOBY <sup>2</sup> based: <i>Acetobacter</i> , yeast & mould	3.11-3.12
	Koji, Miso	<i>Aspergillus</i> , spontaneous or added yeast & LAB	3.10
	Tempeh	<i>Rhizopus</i>	3.9
	Natto	<i>Bacillus</i>	3.8
	Yogurt, Plant-based cheese	Added LAB	3.6-3.7
	Dosa, Idli, Fesikh	Spontaneous LAB and Yeast	3.4-3.5
	Vegetables, Sauerkraut, Kimchi	Spontaneous or added LAB	3.1-3.3

<sup>1</sup>- LAB-lactic acid bacteria; <sup>2</sup>-SCOBY-symbiotic culture of bacteria and yeast

A non-fermented, high alkalinity processed food is also included in this guidance: pidan century egg (Section 3.14).

### Box 1 | How to use the information in this food safety review

The information presented here lays out best practices for a variety of fermented foods, however, it does not replace or supersede federal and provincial guidance or regulatory requirements for fermented foods. Health inspectors, food safety staff, owner and operators of food processing facilities should follow federal and provincial food safety requirements. This work intends to assist food safety staff (health inspectors) to evaluate the safety of fermented foods and fermentation processes encountered during inspections. Owners and operators of food processing facilities may also find this guidance helpful as it reviews critical control points and measures recommended to produce safe fermented foods. The best available evidence guided this work at the time of publication. The application and use of this document is the responsibility of the user.

This guidance does not include information about good manufacturing practices, labelling practices, or management control programs for cleaning and sanitation, pest control, employee training etc. It is expected that operators will follow approved guidance and seek this information elsewhere.

# 3.2 | Dosa and Idli

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## Overview

Description	<div></div> <div></div> <div>Dosa</div> <div>Idli</div> <p>Rice and black gram are soaked, ground and fermented with the addition of salt to form a batter. Batter is fried (dosa) or steamed (idli).</p>
Starter culture	<p>Yeast and wild or spontaneous lactic acid bacteria (LAB) present on ingredients.</p> <p>Backslopping a portion of old culture to the new batch can shorten fermentation time but is not recommended.</p>
Key features	<ul style="list-style-type: none"><li>• Batter is prepared to make dosa or idli for service at the premises, or the dosa/idli batter can be prepared in bulk for commercial distribution.</li><li>• The batter has a short shelf life due to high moisture content.</li><li>• If the batter is not used right away, fermentation will continue to take place, resulting in over-fermentation and affecting product taste and texture- this process can be slowed through refrigeration.</li></ul>
Hazards of concern	<ul style="list-style-type: none"><li>• If pathogens are introduced via contamination of raw ingredients or via cross contamination during preparation, these may proliferate during fermentation, cooling, and storage, however it is expected that wild bacteria will outcompete most pathogens during the fermentation process.</li></ul>
Important control points	<ul style="list-style-type: none"><li>• Care should be taken to avoid introduction of potential pathogens during preparation and fermentation of the batter.</li><li>• Potable water should be used to soak the rice and black gram. Soaking times longer than 4 hrs should occur in refrigerator at or below 4°C.</li><li>• Refrigeration of the batter can prolong shelf life and slow fermentation.</li></ul>

## Background

Dosa and idli are fermented mixtures of cereal (typically rice) and legumes (typically black gram, a bean otherwise known as the urad bean, mungo bean or Haricot urd), primarily prepared and consumed in South and West India and more recently becoming popular in Canada.<sup>1</sup> Preparation of idli is mentioned in literature as far back as 700BC.<sup>2</sup> Dosa and idli may be prepared fresh, or the batter may be pre-prepared and packaged for bulk distribution and commercial sale.<sup>2</sup>

## Outbreaks and Recalls

A search of the CFIA food recall warning and allergy alert database found no recalls or alerts for either dosa or idli in Canada from 1997-2021.<sup>3</sup> Similarly, a broader internet search found no documented recalls for either dosa or idli outside of Canada.<sup>4</sup> Interestingly, a targeted food allergen survey conducted by the CFIA in 2017/2018 to “obtain baseline information regarding the presence and levels of undeclared gluten in gluten-free bakery mixes” identified 2 products (ready to mix rice idli rice cake mix) that contained undeclared gluten, however neither of the identified idli products ultimately led to a CFIA recall or alert.<sup>5</sup>

A review of various published and unpublished data sources and online news articles identified 5 separate outbreaks of gastrointestinal illness following consumption of dosa and/or idli.

**Table 1 | Outbreaks related to dosa and idli products in Canada and elsewhere**

Date	Country	Pathogen causing illness <sup>1</sup>	No. Ill (no. hospitalized)	Premises where outbreak occurred	Reason
2006 <sup>6</sup>	U.S.	<i>Salmonella</i> Typhimurium	3 (1)	Restaurant	Dosa – possible food handler contamination
2012 <sup>7</sup>	India	<i>E. Coli</i> (unspecified)	132 (132)	School	Idli – possible food premise/handler contamination (unlicensed food premise)
2015 <sup>8</sup>	India	Gastroenteritis – causative agent unknown	6 (6) 4 deaths	Home	Dosa & idli – possible food handler contamination
2017 <sup>9</sup>	Sri Lanka	Gastroenteritis – causative agent unknown	74	Refugee camp	Dosa – possible food handler contamination (street food vendors)
2018 <sup>6,10</sup>	U.S.	Enterotoxigenic <i>E. coli</i> (ETEC)	9	Restaurant	Dosa – possible food handler contamination

A review of the publicly available international foodborne outbreak database (PAIFOD; summary prepared on February 7, 2022) found that no foodborne illnesses or outbreaks associated with idli were identified by PHAC to have occurred in Canada or elsewhere between 1985 and 2021.<sup>10</sup> A single outbreak in New York (2018) was identified to be associated with dosa. Enterotoxigenic *E. coli* (ETEC) was linked to illness in 9 suspected cases of enteric illness following consumption of dosa.

A review of the CDC NORS dashboard found two instances of illness linked to preparation and service of dosa in the United States from 1971 to 2018 (*Salmonella*; Georgia 2006; *E. coli*; New York 2018 – also captured in the PAIFOD).<sup>6</sup> It is unclear in either instance if illness was suspected to have occurred from food handler contamination during preparation or service of the dosa, or if dosa was conclusively identified as the food item responsible for causing illness. No illnesses were identified by the CDC to have been associated with consumption of idli during the same time-period.<sup>6</sup>

A broader internet search found one documented outbreak of gastroenteritis associated with consumption of dosa. In this instance 74 cases of gastroenteritis were identified as part of a foodborne illness outbreak at a Sri Lankan refugee camp in India (2017), where consumption of dosa from street food vendors was found on epidemiological analysis to be associated with an increased odds of subsequent enteric illness.<sup>9</sup> No causative pathogen was identified.

Two online newspaper articles were also found. One of these reported 6 of 8 household members in India had reported developing ‘dysentery’ within a few hours of eating dosa and idli prepared from week-old batter, and 4 of these subsequently died.<sup>8</sup> Food poisoning was reported to be the suspected cause of death, however no further information was available regarding the potential pathogen responsible for illness and death or whether the dosa/idli batter was confirmed to be the source of illness.

The second article reported that 132 students at a school in India were hospitalized with vomiting and nausea after consuming idlis at the school.<sup>7</sup> Laboratory testing of the idli identified *E. coli* bacteria, and further investigation reportedly found that the idlis were prepared in a tin shed, without adherence to food safety standards and without registration with the local Food and Drug Administration (FDA).<sup>7</sup>

### **Description of food preparation for dosa and idli**

Dosa and idli are similar in that both are prepared using ground rice and black gram, however they differ in how finely the rice is ground.<sup>1</sup> Idli is generally described in the literature as being prepared via soaking of rice and black gram separately in water at room temperature for a period of 4-6 hours, before the water is drained and the soaked rice coarsely ground.<sup>1,11-14</sup> In order to avoid opportunities for bacterial growth, the rice and black gram should be soaked under refrigeration (4°C or below). If soaking is performed at room temperature, then soaking time should be limited to a maximum of 4 hours. Drained black gram is finely ground, mixed with the soaked rice at a ratio of 3:1 (dosa; rice: black gram)- 4:1 (idli; rice: black gram), and water and 2% of salt are added to form a thick batter, before the mixture is left to ferment naturally overnight (typically at least 12 hours) at around 30°C.<sup>1,11-13</sup> When grinding occurs in a wet grinder with grinding stones or a blender with mechanical blades, operators are advised to include a control step for physical hazards, such as to observe no stone chips or metal fragments occur in the batter. The addition of salt allows LAB, which are halotolerant, to begin metabolism. The metabolism process contributes to acid production, further lowering pH and limiting pathogen growth and survival.<sup>15</sup> After a fermentation time of 12 hours, one study found that the pH of the batter ranged from around 4.3-4.6, depending on the ratio of rice: black gram used.<sup>13</sup>

In warmer climates (such as in India, where dosa and idli are commonly prepared) the batter can be left at room temperature ( $\pm 30^\circ\text{C}$ ) to ferment. In colder climates and depending on the time of year (such as in Canada from fall-spring), the batter may need to be placed in an oven that has been preheated and then turned off (leaving the oven light on) for it to be warm enough ( $\pm 30^\circ\text{C}$ ) for natural fermentation to occur.<sup>16</sup> Salt (non-iodized salt, rock salt, or Himalayan pink salt) should be added prior to fermentation.<sup>16</sup> If fermentation has occurred successfully, the batter should have roughly doubled in volume, and be of a light and fluffy/airy consistency with visible pores and bubbles; well fermented batter should float when dropped into a bowl of water.<sup>12,16</sup>

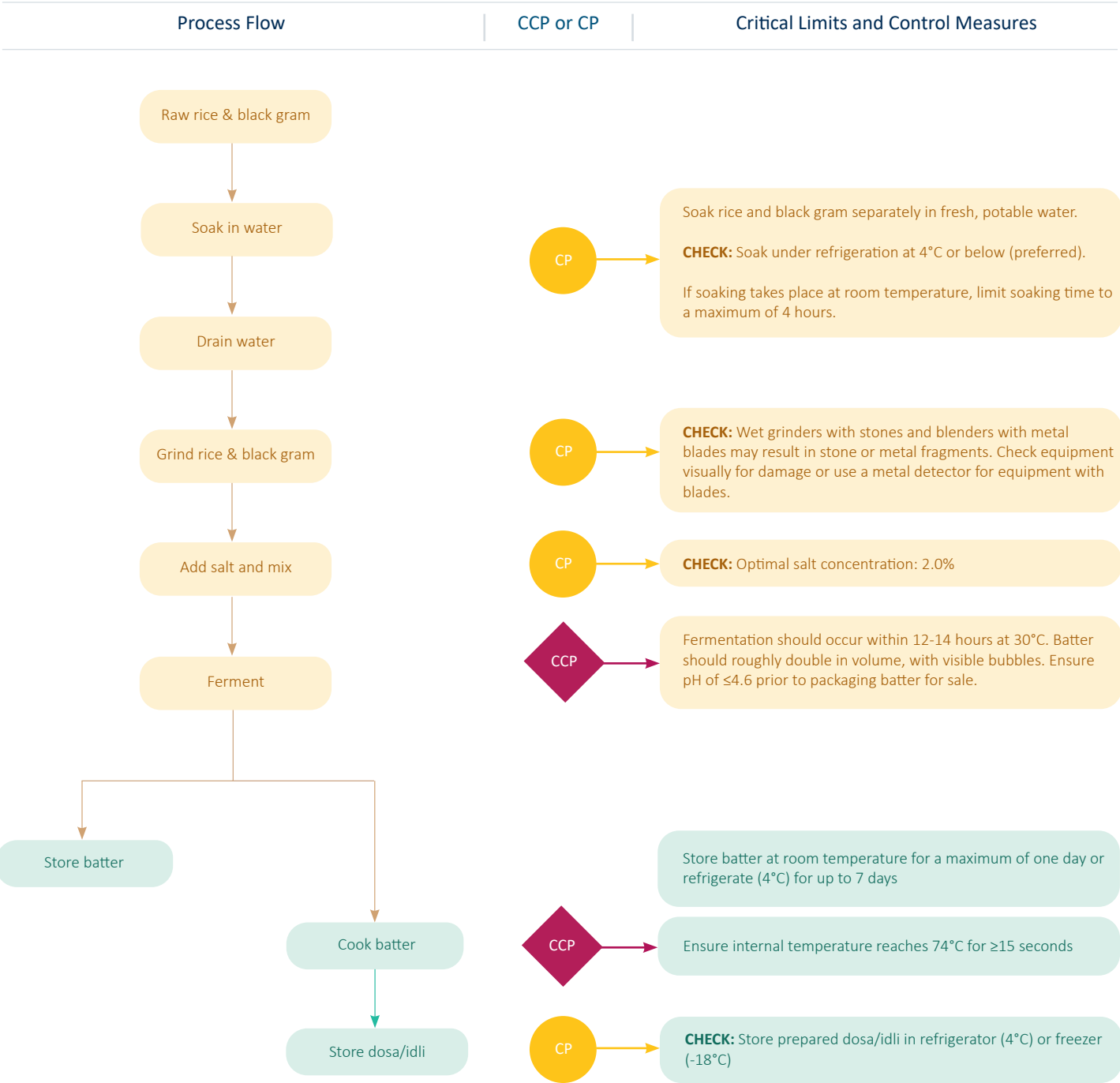
Fermentation time can be decreased from 12-14 hours to around 3 hours via backslopping using naturally fermented and dried idli,<sup>17</sup> however, like other fermented foods, backslopping is not recommended as the use of non-actively fermenting culture can support mould growth. The primary fermentation agents are yeasts, which contribute to leavening and flavour development, and LAB, which contribute to batter acidification and souring.<sup>1</sup>

Once fermentation has occurred, batter is placed in special pans and steamed for five to eight (5 to 8) minutes.<sup>1,11</sup> Once prepared, idli is a savory food with a spongy, cake-like shape and texture.<sup>1</sup>

Dosa is prepared similarly to idli, with the exception that soaked rice is finely rather than coarsely ground and the batter may be prepared at a looser consistency to make it easier to pour.<sup>1,11,12</sup> Dosa batter may be fried and eaten in the form of thin, crispy crepes, or stuffed with boiled potatoes and vegetables (masala dosa).<sup>1</sup> To ensure inactivation of potential pathogens such as *Salmonella* or *E. coli* that may have survived the fermentation process, dosa and idli should reach an internal temperature of 74°C for at least 15 seconds during cooking or reheating, and prior to consumption.<sup>18</sup>

Dosa and idli batter generally have a short shelf life of approximately 1 day at room temperature due to their high moisture content and active fermentation, however, storage in the refrigerator can extend shelf life for approximately 5-7 days.<sup>2,14,19</sup> Although outbreaks reported in the literature for dosa and idli are uncommon, cross contamination during preparation with *E. coli*, *Staphylococcus aureus* or *Bacillus cereus* bacteria that may occur in raw ingredients or be introduced via poor food handling practices represent significant food safety concerns. These pathogens may proliferate during fermentation, cooling and storage and cause illness in the end consumer.<sup>20</sup>

# Dosa and idli food flow chart | Process flow and controls



## Potential issues with dosa and idli food preparation

Issue	Description
Short shelf life	Once prepared, dosa/idli batter has a very short shelf life, which can generally be extended up to 5-7 days through refrigeration. <sup>14</sup> Some studies have shown that shelf life can also be extended via the addition of mustard essential oil (0.1%), which inhibits overgrowth of LAB and yeast and extends shelf life of refrigerated batter up to 30 days <sup>14</sup> , or by the addition of dried curry leaf powder (5%) to the batter, which extends shelf life up to 5 days at 30°C. <sup>21</sup> Sonication (the application of sound energy at a specific frequency) may also extend the shelf life of refrigerated batter for up to 20 days by destroying yeast cells in the batter and slowing the rate of natural fermentation. <sup>2</sup>
Over-fermentation	Once prepared, dosa/idli batter continues to ferment naturally, leading to over-fermentation through overgrowth of naturally occurring microbes and/or inadequate refrigeration. <sup>14</sup> If this occurs, packages of pre-prepared batter may puff up and burst, or idli may become sour and hard-textured once cooked. <sup>14</sup>
Introduction of pathogens	If fresh, potable water is not used <sup>22</sup> , or any pathogens are introduced during preparation of the batter (e.g., via cross-contamination, improper storage), pathogens such as <i>E.coli</i> , <i>Staphylococcus aureus</i> , or <i>Bacillus cereus</i> bacteria may proliferate during soaking, fermentation, cooling and/or refrigeration stages. <sup>20</sup>
Backslopping	Although the use of backslopping may reduce fermentation time <sup>17</sup> , the practice of using non-actively fermenting culture is discouraged due to the potential for undesirable mould growth to be supported, as discussed earlier in the document.
Temperature abuse	<p>As dosa and idli are high moisture foods, these generally have a short shelf life. Soak rice and black gram in the refrigerator at 4°C or below to minimize the growth of bacteria (potential pathogens). If soaking takes place at room temperature, limit to a maximum of 4 hours.</p> <p>Following fermentation, batter not cooked within 24 hours should be stored under refrigeration at 4°C or below and used within 5-7 days (assuming no further additions/treatment to extend shelf-life).</p> <p>Similarly, following cooking, leftover idli/dosa should be pre-cooled before storage in the refrigerator, and reheated prior to consumption.</p> <p>Prolonged cooling at room temperature should be avoided to prevent growth of bacterial pathogens that may have survived the fermentation/cooking process.</p>
Sanitation	To minimize cross-contamination and the introduction of pathogens, ensure all utensils and food preparation containers/surfaces are cleaned and sanitized prior to use. <sup>22</sup>

## Dosa and idli food safety control points

Food safety points described in this section are shown in point form below:

- To limit growth of microbial contaminants, rice and black gram should be soaked in fresh, potable water at 4°C or below. When soaking at room temperature, this step must be completed within a maximum of 4 hours.
- The optimal salt concentration is 2.0%. Salt is added prior to fermentation to support LAB metabolism.
- Fermentation should take place within 12-14 hours (at ±30°C) and it is recommended batter is prepared and refrigerated immediately afterward to prevent over-fermentation. Visual indicators that fermentation has occurred successfully include batter doubling in size, with visible air bubbles.
- Following fermentation, batter must be cooked within 1 day if left at room temperature, or within 1 week if refrigerated. Refrigeration is preferred. Failure to cook batter shortly after completion of fermentation may result in over-fermentation of batter, affecting the taste and/or texture of the food once cooked. Pathogens present in the batter that survive the fermentation process (e.g., spore forming *Bacillus* bacteria) may proliferate above 4°C.

- Leftover prepared dosa/idli must be stored in the refrigerator/freezer and reheated prior to consumption.
- Dosa and idli should be cooked or reheated to an internal temperature of 74°C for at least 15 seconds to inactivate pathogens that may have survived the fermentation process, or that may have been introduced via cross-contamination following fermentation.
- Pre-prepared dosa/idli batter for commercial sale should be verified to have reached a pH of 4.6 or below prior to product packaging.

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