NSW Food Authority

safer food, clearer choices

Potentially hazardous foods

Foods that require temperature control for safety

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NSW Food Authority

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Acronyms used in this document

ANZFA:	Australia New Zealand Food Authority (predecessor to FSANZ)
FSANZ:	Food Standards Australia New Zealand
FSC:	Food Standards Code
IFT/FDA:	Institute of Food Technologists/United States Food and Drug Administration
PHF:	Potentially Hazardous Food
TCS:	Temperature Controlled for Safety
VFSU:	Victorian Food Safety Unit

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EXECUTIVE SUMMARY

Potentially Hazardous Food (PHF) must be displayed and stored in a manner that minimises the growth of pathogenic bacteria and bacteria that can form toxins in food. Temperature control is the simplest and most effective way of controlling the growth of bacteria.

The Australian requirements for the storage and display of potentially hazardous foods are:

- PHF must be stored and displayed below 5°C or above 60°C
- PHF must be thrown out if stored or displayed at temperatures between 5° and 60°C more than four hours
- PHF must be used immediately if stored or displayed between 5° and 60°C for between two and four hours
- PHF may be either refrigerated or used immediately if stored or displayed at between 5° and 60°C for less than two hours

Food businesses can change these requirements if they demonstrate that some other practice will minimise the growth of pathogenic bacteria and the toxin production by bacteria. Scientific expertise and laboratory testing is required to demonstrate that any other practice is effective.

Some meal ingredients, meal replacements and snacks—often manufactured foods—are not potentially hazardous. However, meals whether served at home or in a food service setting should be assumed to be potentially hazardous. Even a single PHF on a plate ensures that the meal is potentially hazardous but often every component will be a PHF.

Options available under the "4-hour/2-hour rule"

Time at 5°C- 60°C		
0-2 hours	**2-4 hours**	**Over 4 hours**
Use immediately	Discard	Discard
or	or	
Return to refrigerator	Use immediately	

REGULATIONS AND GUIDELINES

Food Standard 3.2.2 defines potentially hazardous food as "food that has to be kept at certain temperatures to minimise the growth of any pathogenic microorganism that might be present in the food or to prevent the formation of toxins in the food". Clause 8 of that Standard requires that a food business, when displaying potentially hazardous food, display it under temperature control.

These clauses are simple and logical. However, when it comes to inspecting food on display the situation is not always as simple. In some cases it is not possible during an inspection to determine if a food is potentially hazardous. While the food business has the responsibility to demonstrate that it is handling food safely, many small businesses are not equipped to do so.

This document includes information on factors that can be used to assess the hazard, lists of food types where the nature of the hazard can be determined and provides information on what laboratory work can be done to provide clarity when the nature of the hazard is not clear.

Australian definition of Potentially Hazardous Food

Standard 3.2.2 – Food Safety Practices and General Requirements of the Food Standards Code defines a potentially hazardous food as:

> *Food that has to be kept at certain temperatures to minimise multiplication of any food-poisoning bacteria that may be present in the food or to prevent the formation of toxins in the food.*
>
> Potentially hazardous foods are foods that meet both of the criteria below:

- They might contain the types of food-poisoning bacteria that need to multiply to large numbers to cause food poisoning, and
- The food will allow the food-poisoning bacteria to multiply.

The associated definition of temperature control is important. It means "maintaining food at a temperature of:

(a) 5°C, or below if this is necessary to minimise the growth of infectious or toxic microorganisms in the food so that the microbial safety of the food will not be adversely affected for the time that the food is at that temperature, or

(b) 60°C or above, or

(c) Another temperature—if the food business demonstrates that maintenance of the food at this temperature for the period of time for which it will be so maintained, will not adversely affect the microbiological safety of the food".

Clause 25 of the Standard sets out requirements for the use of other temperatures. Guidance on the Standard is provided in *Safe Food Australia* (ANZFA 2001). Appendix 1 of that document provides guidance on the use of time as a control for potentially hazardous food and summarises the "4-hour/2-hour rule" as follows:

> Any ready-to-eat potentially hazardous food, if it has been at temperatures between 5°C and 60°C:

- For a total less than two hours, must be refrigerated or used immediately,
- For a total of longer than two hours but less than four hours, must be used immediately, or
- For a total of four hours or longer, must be thrown out.

If a food business wishes to maintain potentially hazardous food between the temperatures of 5°C and 60°C for time periods longer than the two hours and four hours specified above, it will need to demonstrate that the extension of time will not compromise the safety of the food.

Institute of Food Technologists/United States Food and Drug Administration suggested definition of Potentially Hazardous Food

The Institute of Food Technologists/US Food and Drug Administration (IFT/FDA) report on *Evaluation and Definition of Potentially Hazardous Foods* suggests adopting the term "temperature controlled for safety (TCS)" with the definition "foods that require time/temperature control to limit pathogen growth or toxin formation that constitutes a threat to public health". This definition has similar intent to that used in Food Standard 3.2.2.

The report goes on to consider factors that influence microbial growth and provides useful guidance on determining if a product requires TCS. Given the similarities in definitions the IFT/FDA guidance also addresses Australian FSC requirements. Much of the analysis that follows is based on the IFT/FDA model.

The report also includes a critique if the current FDA definition of PHF. The definition, which is quite prescriptive but also informative, is included as Appendix 5.

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HOW TO DETERMINE IF FOODS ARE POTENTIALLY HAZARDOUS

Water Activity (a_w) as the control factor for pathogen growth

The water activity of a food describes the degree to which water is "bound" in the food, its availability to participate in chemical/biochemical reactions and it ability to make possible the growth of microorganisms (IFT/FDA, 2001). Most fresh foods have a_w values that are close to the optimum growth level of most microorganisms (0.97 to 0.99). Appendix 1 is a table showing the minimum a_w at which foodborne pathogenic bacteria can grow or produce toxin. The yardstick organism is *Staphylococcus aureus* which can grow at a_w 0.83 and produce toxin at 0.88.

pH as the control factor for pathogen growth

The pH of a food relates to its acidity. Appendix 3 shows the minimum pH at which foodborne pathogenic bacteria can grow or produce toxin. The yardstick vegetative bacteria are *S. aureus* which can grow at pH 4.0 and produce toxin at 4.6 and *Yersinia enterocolitica* and *Salmonella* spp. both of which can grow at pH 4.2. The spore-forming bacteria of interest is *Clostridium botulinum* which can grow and produce toxin down to pH 4.6.

Interactions between pH and a_w

The tables below (after IFT/FDA, 2001) provide a useful advice on some combinations of pH and water activity which, taken together, will prevent microbial growth or spore outgrowth. Those combinations that lead to "non-TCS" are not PHF. If the combination is denoted by a "?" it indicates that the product is potentially unsafe without refrigeration. Some individual foods have characteristics that prevent pathogen growth at conditions of pH and water activity that are less severe than those indicated in the tables.

If the product of interest has been heat treated to destroy vegetative microbial cells and has been packaged to avoid recontamination, use Table A to ascertain the need for temperature control, otherwise use Table B.

IFT/FDA Table A -
Product treated to control spores and protected from recontamination

		pH				
		<4.2	4.2-4.6	>4.6-5.0	>5.0-5.6	>5.6
Water activity	<0.85					
	>0.85-<0.88					
	0.88-0.90					
	>0.90-0.92					
	>0.92-0.95					?
	>0.95			?	?	?

IFT/FDA Table B -
Product not treated to control spores or treated but not protected from recontamination

Water activity	pH <4.2	4.2-4.6	>4.6-5.0	>5.0-5.6	>5.6
<0.85					
>0.85-<0.88					
0.88-0.90				?	?
>0.90-0.92			?	?	?
>0.92-0.95		?	?	?	?
>0.95		?	?	?	?

Non-TCS

? Query area - Possible TCS - Individual product assessment required

Foods that are not PHF

Table 1: Not PHF/Not TCS

Food type	
Dry goods	Unopened canned foods
Pickles	Sauces - Ketchup style
Salad dressings	Sauces - Asian/Soy
Bottled marinades	Bottled salsas
Bottled pasta sauces	Raw whole fruit and vegetables
Nuts in the shell	Dried fruit
Salted dried meats	Fermented dried meats
Honey and jam	Peanut butter
Fruit cake	Plain cakes
Biscuits and crackers	Plain breads and bread rolls
Hard cheeses	Yoghurts
Fruit juices	Confectionary

Important notes:

Foods in the above list do not support the growth of pathogenic bacteria or the formation of toxins in the food. However:

1. Many of the products require refrigerated storage to prevent food spoilage or maintain quality to achieve the stated shelf life.

2. Some of the products might harbour, but not support the growth of, enteric viruses or pathogenic bacteria such as enterohaemorrhagic strains of *E. coli* or *Salmonella*. They can be "not potentially hazardous" but still a food safety hazard. For example, foodborne illness has resulted from the consumption of peanut butter and unpasteurised juices.
3. The above foods might become potentially hazardous when the food is opened or altered in some way. For example, opening a can of beef stew, slicing a melon, cooking vegetables or wetting dry foods.

Potentially Hazardous Foods

Table 2: PHF/TCS

Food type[1]	Example or comment
Raw or cooked meat	Including poultry or game
Foods containing raw or cooked meat	Casseroles, curries, lasagne
Smallgoods	Devon, ham, chicken loaf
Dairy products	Milk, custard, dairy desserts, unbaked cheesecake, custard tarts
Seafood (excluding live seafood)	Seafood salad, soup, fish sticks, stews
Processed fruit and vegetables	Salads, cut melons
Cooked pasta and rice	
Foods containing eggs, beans, nuts or other protein-rich foods	Quiche, fresh pasta, soy bean products
Foods containing the above foods	Sandwiches, rolls, uncooked and cooked pizza

Note 1: Examples from the FSANZ guide on temperature control of Potentially Hazardous Foods (FSANZ, 2002).

It is important to note that the foods in Table 1 are components or ingredients of a meal. Many are manufactured foods. However, most of the foods in Table 2 could well be the centrepiece of a meal. In general the mix of foods consumed at a meal will include potentially hazardous foods.

COMMON ISSUES

Warm food (less than 60°C) in a bain marie

A correctly adjusted bain marie can hold food at 60°-65°C without generating too much steam. If food on display is less than 60°C the unit could be set too low or the operator might have used the bain marie to reheat food. The bain marie is not designed for reheating food. If attempted the food typically spends many hours at a perfect temperature for bacterial growth. Food must be freshly cooked or reheated prior to display in a bain marie.

Salads and cut meats displayed above 5°C

It is common for salad and sandwich bars to display cold food at 5-10°C and it can be difficult to correct without significant investment. Brightly lit displays, with "cold plate" refrigeration, stacked high with food to be more appetising, are more difficult to manage than compact displays with overhead cooling.

Sometimes the problem can be traced to operator actions, such as placing spacers (cardboard, foam or bread) between the cold plate and the food tray to avoid freezing. In this case the use of plastic trays might be a better option.

Often the only solution available to operators is to display suitable quantities of food and to remove food from display consistent with the "4-hour/2-hour rule". Condiments, sauces and other non PHF do not have to follow the rule.

Pre-cut sandwiches and rolls

Sandwich shops sometimes prepare sandwiches ahead of the lunch rush hour. Sandwiches are a potentially hazardous food and time or temperature control is necessary. If adequate refrigeration is not available then sandwiches must be sold within the 4-hour time frame and time control must be evident.

Ambient or cool display of sushi

Sushi businesses are sometimes reluctant to refrigerate product because changes to rice starch can result in a firmer texture and starchy taste. Businesses often claim there is no risk because the rice is vinegared. However there are two problems:

- When the NSW Food Authority surveyed sushi 16% of vinegared rice was found to be above pH 4.6 and in a range where food poisoning bacteria can grow. When the average pH of sushi products was measured 72% samples were above 4.6 and clearly not all components of sushi are acidified by the vinegared rice.
- Sushi is prepared by hand and has an increased risk of contamination.

In summary, some components of the sushi remain potentially hazardous as there is evidence of the use of inadequately vinegared rice and sushi can be contaminated during preparation. The Food Authority considers sushi to be a potentially hazardous food that must be displayed under time or temperature control. Further information is included in the sushi guidelines published by the NSW Food Authority (2007).

Ambient display of seemingly perishable Asian foods

Anecdotally, Asian communities have a tradition of "cook–serve" food service and equate refrigerated products to old or stale food. However, for many Asian specialties "cook–serve" has been replaced by a longer supply chain that includes centralised processing, overnight (or early morning) delivery and extended display times often with no temperature control. Even when foods are prepared at the retail premises, if temperature and time controls are lacking it

is not possible to comply with Food Standards Code requirements for display of potentially hazardous foods.

The wide variety of often unfamiliar foods might present a challenge for Environmental Health or Food Safety Officers. Most products will be exactly as they seem—potentially hazardous. A small number of foods appear potentially hazardous but previous studies have revealed that they are low risk foods.

Chinese roast duck and pork: NSW Health previously reviewed these products and established a tolerance for BBQ shop practices. The Victorian Food Safety Unit (VFSU) also studied Chinese roast meats and established specific food safety plans for the products.

The NSW Food Authority's policy is that traditionally prepared BBQ pork, duck and chicken on the day of preparation are low risk products until they are cut up for sale. After carving the protection provided by scalding, surface drying and roasting in a salty-sugary glaze is lost and the products become perishable and potentially hazardous. The products then must follow the "4-hour/2-hour rule".

The VFSU website includes additional information on BBQ shop products. It is important to note that the "low risk" status does not extend to the miscellaneous products sold by the BBQ shops such as gizzard, squid and tongue.

Some BBQ shops prepare large batches of roast meats early in the day and sell them until the shop closes. Other shops prepare smaller batches several times through the day. The latter practice is consistent with VFSU guidelines and recommended by the NSW Food Authority.

South East Asian baked products: Mung bean cakes, mung bean paste and Muscat have low a_w and are not potentially hazardous. Other SE Asian baked cakes have been described by the VFSU as medium risk. Like many other cakes, under the IFT/FDA model they are in the query zone. Most are likely to stale or go mouldy (the so called "spoil safe") prior to the development of a food safety issue. Details of the VSFU and TCS classifications are included in Appendix 6.

Asian meals, noodles, rice rolls and desserts: The products are classified as high risk by the VFSU. They are classed "TCS?" under the IFT/FDA model. Results for individual products are shown in Appendix 6. Previous surveys of these products identified significant levels of microbiological contamination.

> South West Sydney Area Health Service completed a small survey in 1992 (unpublished) and identified many products with elevated standard plate counts and a number of products positive for *E. coli* and *Bacillus cereus* – including some high results. A follow up survey in 1993 (unpublished) found that results varied between manufacturers but confirmed the 1992 results. The report concluded that the studies demonstrated significant levels of contamination with foodborne bacteria of public health significance.
>
> Central Sydney Area Health Service (Karalis 2001) reported failings in manufacturing standards and microbiological profiles amongst 71 Asian foods sampled from 15 manufacturers. *B. cereus* was found in 15 products, most commonly in foods based on soya beans, at levels from 50 to 1.1 X 10^6 cfu/mL.

Baked goods

pH and a_w measurements result in fresh cream and custard filled bakery products being classified as potentially hazardous and thus subject to temperature or time control for safety. This is supported by a history of food poisoning (caused primarily by *Salmonella* and less frequently *Staphylococcus aureus* and *Bacillus cereus*) attributed to these products.

Mock cream filled products, tarts, cookies, plain cakes and muffins are typically stored at ambient temperature on the day for which they were manufactured. The products have a relatively low a_w, a much drier protective crust and a long established history of safe ambient storage.

The pH or a_w of bread and cakes are generally not low enough to classify the products as not potentially hazardous. However, other characteristic such as the dry protective crust mean that plain bread does not require refrigeration for food safety reasons. Bread rolls with baked-on ham and cheese toppings are not potentially hazardous. However, products that have recently been introduced to the market with readily perishable fillings or fillings added after baking have been classified as potentially hazardous. They are generally displayed in warm display cases under time control (the 4-hour/2-hour rule).

ALTERNATIVE METHODS OF COMPLIANCE

Clause 25 of Food Standard 3.2.2 outlines how food businesses can demonstrate that an alternative system of time or temperature control will not adversely affect the microbiological safety of the food.

Food Regulation 2004 establishes how the use of the word “demonstrate” in the Food Standards Code is to be interpreted:

> Clause 4 (1) (d) to demonstrate is to be read as a reference to demonstrate to the satisfaction of the Director-General (of the NSW Food Authority).

Demonstrating alternative compliance

Companies may demonstrate alternative compliance by having competently drafted and validated food safety plans. However, food safety plans are not routinely used in the food sectors where the common issues (identified above) are encountered. If a food safety program is used to demonstrate compliance it must identify the risks inherent in food display. If the food is potentially hazardous then the controls employed for safe display must be validated and systematically monitored. This approach has been used by the VFSU for Chinese roast meats.

Companies may also demonstrate compliance based on sound scientific evidence or written guidelines published by the relevant food industry. In both cases there must be documentary evidence of the completion of a suitable study. This will often be a challenge study, which is discussed in the next section, but could also be based on microbiological growth models or an expert report.

Individual product assessment

The IFT/FDA report includes details of individual product assessment. The steps set out in the report should be undertaken under the guidance of a trained food technologist or food scientist. Laboratory analysis is required to complete the assessment.

Step A: Evaluate the affects of pH, a_w and pH/a_w interactions for the food product. If the product is not homogeneous measurements of water activity and pH are required in triplicate for each component. The assessment of a food that is not homogenous will be based on the “weakest link”.

Step B: Evaluate the results of testing according to the appropriate IFT/FDA table. Use Table A if the product is processed (eg cooked) to control vegetative cells and protected from recontamination. Use Table B if the product is not treated to control vegetative cells or treated but not protected from recontamination. If the product is classified non-TCS the assessment is complete.

Step C: If the product is in the query area then time or temperature controlled display is required. Further studies can be undertaken if necessary but time or temperature controls are often better options. The studies are complex and expensive and advice from an experienced food technologist/scientist could be cost effective at this point. The advice should consider factors such as:

- Potential pathogens
- Intrinsic factors such as preservatives, acidulants, nutrients, humectants
- Extrinsic factors such as packaging, modified atmosphere, shelf life
- Effectiveness of the processing for control of pathogens

- Possible post-process recontamination
- Historical information on the safety of similar or related products

The consultant could also use microbial growth models to indicate the likely success of challenge studies.

Step D: Microbial challenge tests should be undertaken if there is a reasonable likelihood of success. NSF-ANSI Standard 75-2000, which is reproduced in the IFT/FDA report, provides useful guidance on challenging testing. Products passing a properly designed challenge test are considered to have demonstrated alternative compliance so long as controlled display times and temperatures do not exceed those employed in a successful challenge trial.

Note 1: The results of microbiological testing of the food product are useful for verification of the assessment but they do not stand alone. Good results might provide a level of comfort about product safety but they do not necessarily address all the inherent risks.

Note 2: The history of the product alone does not confirm product safety. The history must be underpinned by a sound scientific evaluation.

CONCLUSION

There are a number of important questions that a business must answer when deciding if temperature or time control is required for food on display:

1. Might the food contain a pathogen that can cause food illness if it multiplies? With a few exceptions, such as commercially canned foods, the answer to this question is "yes". Cooked foods can have residual contamination in the form of heat resistant spores. Foods handled after cooking are exposed to further contamination by pathogenic bacteria.
2. Will the food support the growth of pathogenic bacteria? The tables and charts above and in the Appendices provide guidance on this question. All or parts of most meals will readily support pathogen growth and their safety is dependant on temperature or time controlled display.
3. Is the food too dry to support pathogen growth? The answer is "yes" for a few ready-to-eat foods such as traditional salami, jerky and fruit cake. For most foods the answer is "no" and pathogen growth can occur. A laboratory test for water activity can provide an answer but the most perishable components of the food must be tested.
4. Is the food too acid to support pathogen growth? For some products such as pickles, sauces and fruit juices the answer is "yes". For most ready-to-eat foods the answer is "no". A laboratory test for pH can provide an answer but again the most perishable components must be tested.
5. Are there other factors that might make the food safe?

The final question leads businesses into food technology, expert advice and laboratory testing. If there are sound technical reasons that make temperature or time control unworkable then the business might have no choice other than to seek an answer to this question.

This protocol is a guide and does not replace good science or good judgment applied by the business to their product and process. Furthermore, this protocol does not limit the ability of the manufacturer to develop additional data beyond those described in this protocol to demonstrate the safety of their food product.

The NSW Food Authority considers that any food product that fails to meet the definition of "not potentially hazardous" is subject to the temperature control requirements of the Food Standards Code.

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REFERENCES AND FURTHER READING

ANZFA (2001), *Safe Food Australia, A Guide to the Food Safety Standards*, http://www.foodstandards.gov.au/_srcfiles/complete_safefood.pdf

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Karalis et al (2001), *Microbiological status of Asian style perishable foods and the relation with procedural deficiencies in manufacture*, Food Australia, 53 (5), May 2001.

NSWFA (2007), *Food Safety Guidelines for the Preparation and Display of Sushi*, http://www.foodauthority.nsw.gov.au/industry/pdf/Sushi-Guidelines-Eng.pdf

APPENDICES

1. Water activity as the control factor for pathogen growth

Approximate water activity (a_w) values for growth of selected pathogens in food (adapted from IFT/FDA, 2003)

Organism	Minimum a_w for growth
Campylobacter spp.	0.98
Clostridium botulinum type E	0.97
Shigella spp.	0.97
Yersinia enterocolitica	0.97
Vibrio vulnificus	0.96
Enterohaemorrhagic *Escherichia coli*	0.95
Salmonella spp.	0.94
Vibrio parahaemolyticus	0.94
Bacillus cereus	0.93
Clostridium botulinum types A & B	0.93
Clostridium perfringens	0.943
Listeria monocytogenes	0.92
Staphylococcus aureus	
toxin production	0.88
growth	0.83

2. Estimation of water activity during an inspection

Battery powered instruments are available for a_w estimation. The instruments cost several thousand dollars. They are good for screening products but borderline results should be confirmed by a NATA accredited laboratory.

With mixed foods it is important to test the most perishable component. This is usually the moist component such as cream or custard fillings rather than the cake or pastry case. Calibration is important and the manufacturer's instructions must be followed.

Food a_w values

Product	aw
Fresh meat, poultry fish	0.99 to 1.00
Fresh fruit, vegetable	0.97 to 1.00
Pudding	0.97 to 0.99
Cured meat	0.97 to 0.95
Eggs	0.97
Natural cheese	0.95 to 1.00
Bread – white	0.94 to 0.97
Baked cake	0.90 to 0.94
Sweetened condensed milk	0.83
Uncooked rice	0.80 to 0.87
Cake icing	0.76 to 0.84
Jam	0.75 to 0.80

Product	aw
Honey	0.75
Fruit cake	0.73 to 0.83
Parmesan cheese	0.68 to 0.76
Flour	0.67 to 0.87
Dried fruit	0.55 to 0.80
Dried whole egg	0.40
Bread – crust	0.30
Dried whole milk	0.20
Sugar	0.19
Cereal	0.10 to 0.20
Crackers	0.10

3. pH as the control factor for pathogen growth

Approximate pH values for growth of selected pathogens in food (adapted from IFT/FDA, 2003)

Organism	Minimum pH for growth
Clostridium perfringens	5.5 – 5.8
Vibrio vulnificus	5.0
Campylobacter spp.	4.9
Shigella spp.	4.9
Bacillus cereus	4.9
Vibrio parahaemolyticus	4.8
Clostridium botulinum	
toxin production	4.6
growth	4.6
Staphylococcus aureus	
toxin production	4.6
growth	4.0
Enterohaemorrhagic *Escherichia coli*	4.4
Listeria monocytogenes	4.39
Yersinia enterocolitica	4.2
Salmonella spp.	4.2

4. Estimation of pH during an inspection

Battery powered instruments are available for pH estimation. Unlike a_w instruments they are relatively inexpensive. The most economical instruments use a glass electrode and these are not suitable for use adjacent to exposed food. Non-glass probes are available and these are clearly preferable in food service areas. pH meters must be calibrated. Borderline results should be verified by an accredited laboratory.

pH paper or strips can also be used with caution in foods. Narrow range strips that cover about pH 3 to pH 7 are preferred. Results in the critical range between pH 4 and pH 5 should be confirmed by an accredited laboratory.

Food pH Values

Product	pH
Camembert cheese	7.4
Cake chocolate	7.2 to 7.6
Egg white	7.0 to 9.0
Fish fresh (most)	6.6 to 6.8
Chicken	6.5 to 6.7
Egg yolk	6.4
Potatoes	6.1
Corn	6.0 to 7.5
Rice cooked	6.0 to 6.7
Ham	5.9 to 6.1
Cheddar cheese	5.9

Product	pH
Peas	5.8 to 7.0
Lamb	5.4 to 6.7
Bread	5.3 to 5.8
Papaya	5.2 to 5.7
Beef minced	5.1 to 6.2
Cottage cheese	5.0
Carrots	4.9 to 5.2
Mayonnaise	4.2 to 4.5
Oranges	3.1 to 4.1
Jam	3.1 to 3.5

5. United States Food and Drug Administration definition of Potentially Hazardous Food

a. **"Potentially hazardous food"** means a food that is natural or synthetic and that requires temperature control because it is in a form capable of supporting:

   i. The rapid and progressive growth of infectious or toxigenic microorganisms;

   ii. The growth and toxin production of ***Clostridium botulinum***; or

   iii. In raw shell eggs, the growth of ***Salmonella*** **Enteritidis**.

b. **"Potentially hazardous food"** includes an animal food (a food of animal origin) that is raw or heat-treated; a food of plant origin that is heat-treated or consists of raw seed sprouts; cut melons; and garlic-in-oil mixtures that are not modified in a way that results in mixtures that do not support growth as specified under Subparagraph (a) of this definition.

c. **"Potentially hazardous food"** does not include:

   i. An air-cooled hard-boiled egg with shell intact;

   ii. A food with an aw value of 0.85 or less;

   iii. A food with a pH level of 4.6 or below when measured at 24°C;

   iv. A food, in an unopened hermetically sealed container that is commercially processed to achieve and maintain commercial sterility under conditions of non-refrigerated storage and distribution;

   v. A food for which laboratory evidence demonstrates that the rapid and progressive growth of infectious or toxigenic microorganisms or the growth of ***S.*** **Enteritidis** in eggs or ***C. botulinum*** can not occur, such as a food that has an a_w and a pH that are above the levels specified under Subparagraphs (c)(ii) and (iii) of this definition and that may contain a preservative, other barrier to the growth of microorganisms, or a combination of barriers that inhibit the growth of microorganisms; or

   vi. A food that does not support the growth of microorganisms as specified under Subparagraph (a) of this definition even though the food may contain an infectious or toxigenic microorganism or chemical or physical contaminant at a level sufficient to cause illness.

6. Temperature control recommendations – Previously considered products

Description	Pathogen risk	pH control	a_w control	pH + a_w control	Other hurdles	Comment	TCS
Section 1: South East Asian foods							
Che Chuoi Banana Pudding	Yes	No	No	No	No	VFSU[1] High Risk	Yes
Banh Cuon Rice Rolls	Yes	No	No	No	No	VFSU High Risk	Yes
Banh Bia Mung Bean Cake	Yes	No	Yes	Yes	Crust	VFSU Low Risk	No
Banh Trung Thu Mung Bean Paste	Yes	No	Yes	Yes	Crust	VFSU Low Risk	No
Banh Duc Pandan Slices	Yes	No	No	No	No	VFSU High Risk	Yes
Xoi Ngoy Rainbow Rice	Yes	No	No	No	No	VFSU High Risk	Yes
Fatt Koh Rice Cake	Yes	No	No	No	?	VFSU Medium Risk	?
Banh Da Lon Layered Cake	Yes	No	No	No	E281	VFSU - High Risk	Yes
Banh Trung – Egg Tart	Yes	No	No	No	? Surface	VFSU Medium Risk	?
Che Chuoi Green Bean Jelly	Yes	No	No	No	No	VFSU Medium Risk	Yes
Kueh Dadah Ketayup	Yes	No	No	No	No	VFSU Medium Risk	?

Description	Pathogen risk	pH control	a_w control	pH + a_w control	Other hurdles	Comment	TCS
Pink Sago	Yes	No	No	No	No	VFSU – Not classified	Yes
Kaya Coconut Jam	Yes	No	No	No	No	VFSU Medium Risk	?
Fresh Coconut Glutinous Rice	Yes	No	Varies	Varies	?	VFSU Medium Risk	?
Char Kueh	Yes	No	No	No	No	VFSU High Risk	Yes
Che Dau Trang Bean Rice Pudding	Yes	No	No	No	No	VFSU High Risk	Yes
Che Troi Nuoc Vietnamese Dessert	Yes	No	No	No	No	VFSU High Risk	Yes
Che Ba Mau Vietnamese Dessert 3	Yes	No	No	No	No	VFSU High Risk	Yes
Che Tao Son Sweet Mung Bean and Coconut	Yes	No	No	No	No	VFSU High Risk	Yes
Iddi Appa String Hopper	Yes	No	No	No	No	VFSU High Risk	Yes
Moong Kawun Mung Bean Cakes	Yes	No	Yes	Yes	? Surface	VFSU Low Risk	No
Coconut Roti	Yes	No	No	No	? Surface	VFSU Low Risk	?

Description	Pathogen risk	pH control	a_w control	pH + a_w control	Other hurdles	Comment	TCS
Coconut Pittu	Yes	No	No	No	? Surface	VSFU Medium Risk	?
Banh Khoai Mi Cassava Snakes	Yes	No	No	No	? Surface E281	VFSU Low Risk	?
Coai	Yes	No	No	No	? Surface	VFSU Unclassified	Yes
Kanom – Tien	Yes	No	No	No	? Surface	VFSU Medium Risk	?
Froy Thong	Yes	No	Varies	Varies	? Surface	VFSU Low Risk	?
Toddy Palm Cake	Yes	No	No	No	? Surface	VFSU Medium Risk	?
Mho Gang Thai	Yes	No	No	No	? Surface	VSFU Unclassified	Yes
Taro Cake	Yes	No	No	No	? Surface	VFSU Unclassified	Yes
Sticky Rice & Egg Custard	Yes	No	No	No	No	VFSU Unclassified	Yes
Nanun	Yes	No	No	No	No	VFSU Medium Risk	Yes
Rice Cake with Chives	Yes	No	No	No	? Surface	VFSU Medium Risk	Yes
Jro Dov	Yes	No	No	No	No	VFSU High Risk	Yes
Moc Kwa Vietnamese Dessert	Yes	No	No	No	No	VFSU High Risk	Yes
Muscat	Yes	No	Yes	Yes	? Surface	VFSU Low Risk	No
Banh Chuoi Nuong Banana Cake	Yes	No	No	No	? Surface	VFSU Medium Risk.	?

Description	Pathogen risk	pH control	a_w control	pH + a_w control	Other hurdles	Comment	TCS
Banh Gan Caramel Cake	Yes	No	No	No	? Surface	VFSU Medium Risk	?
Goi Cuon	Yes	Varies	No	Varies	No	VFSU Medium Risk	Yes
Banh Tam Bi	Yes	No	No	No	No	VFSU Medium Risk	Yes
Cha Lanh Fish Cake	Yes	No	No	No	? Surface	VFSU Medium Risk	Yes
Banh Bo Nuong Cake	Yes	No	No	No	? Surface	VFSU Medium Risk	?
Nem Chua	Yes	No; Close	No	No; Close	Vinegar	VFSU Medium Risk	?
Banh Uoc	Yes	No	No	No	No	VFSU High Risk	Yes
Banh Beo Rice Cup Cakes	Yes	No	No	No	No	VFSU High Risk	Yes
Gluten (wet)	Yes	No	No	No	No	VFSU High Risk	Yes
Yow Char Kway Fried Buns	Yes	No	Yes	Yes	Crust	VFSU Medium Risk	No
Pork Loaf (Rolled in Banana leaf)	Yes	No	No	No	No	VFSU Medium Risk	Yes
Chee Cheong Fun Rice Noodle	Yes	Varies	No	Varies	No	VFSU High Risk	Yes
Yam Cake	Yes	No	No	No	No	VSFU High Risk	Yes
Section 2: Southern European foods							
Tiropita Cheese Pie	Yes	No	No	No; Close	Crust	VFSU Medium Risk	?

Description	Pathogen risk	pH control	a_w control	pH + a_w control	Other hurdles	Comment	TCS
Spanakopita Spinach Pie	Yes	No	No	No; Close	Crust	VFSU Medium Risk	?
Section 3: South Asian foods							
Aloo Paratha	Yes	No	No	No	No	VFSU High Risk	Yes
Barfi	Yes	No	Yes	Yes	No	VFSU Low Risk	No
Barfi Pistachio	Yes	No	Yes	Yes	No	VFSU Low Risk	No
Section 4: Sushi							
California Roll	Yes	No	No	No	Vinegar	VFSU Medium Risk	Yes
Acidified Sushi Rice	Yes	Yes	No	Yes	Vinegar	pH controlled in 20/37 samples	No
	Yes	No	No	No	Vinegar	pH varies from 4.3 to 6.4 in 17/37 samples	Varies
Non-acidified Sushi Rice	Yes	No	No	No	No		Yes
Bakery products[3]							
Mock-cream Match	Yes	No	Yes	Yes	?		No
Mock-cream Bun	Yes	No	Yes	Yes	?	Some samples have inconsistent results	No
Neenish Tart	Yes	No	Yes	Yes	?		No
Fruit Filled Pie / Turnover / Danish	Yes	Yes	No	Yes	Crust		No
Caramel Slice	Yes	No	Yes	Yes	Crust		No

Description	Pathogen risk	pH control	a_w control	pH + a_w control	Other hurdles	Comment	TCS
Muffins, Plain Cakes	Yes	No	No	No; Close	Crust	IFT Table A[2] provides better guidance + history	No
Custard Filled	Yes	No	No	No	Varies	Some custards use preservative – further study required	Yes?
Meat Topped	Yes	No	No	No	Crust	IFT Table A provides better guidance if crust undisturbed + history – further study required	No?
Fresh Cream Filled	Yes	No	No	No	No		Yes
Meat Pie	Yes	No	No	No	Crust	More work required	Yes?

Note 1: VFSU classifications are from *Atlas of ready-to eat foods* published by the Food Safety Unit, Department of Human Services, State Government of Victoria.

Note 2: TCS determinations are based on IFT/FDA Table B except where noted.

Note 3: Many traditional bakery products are intended to be consumed on the day of baking or the following day. Some of the safety provided by the dry crust is diminished when fillings or gravies dampen the crust.

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