Risk Perception and Food Safety
A study on the perceived risks associated with using recycled water in food products

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technical risk vs. risk as a social construct

• **Technical risk** “the probability of occurrence multiplied by the magnitude of the consequences” (adapted from Yeung & Morris, 2001)
  • an expected average value for a risky situation based on the sum of the products of possible outcomes and their respective relative probabilities

• **Criticism: outcomes and probabilities often unknown**
  • “uncertainty” rather than “risk”.
  • When uncertain, consequences become more salient

• **Risk as a social construct**
  • an expression of the tensions inherent in given social and cultural contexts (Nelkin, 1989)
  • the social and psychological characteristics of the (food) hazard (Slovic, 1993)
Risk characteristics (Slovic, 1987)

- severity of consequences,
- control over risk,
- immediacy of effect,
- voluntariness of risk,
- knowledge about risk,
- newness,
- chronic-catastrophic,
- common-dread
- Unknown
- Extent of society’s exposure
- trust

- Inter-related
- Hazards perceived to be voluntary tend to be judged controllable;
- hazards with delayed adverse effects tend to be “unknown” to the public
Food risks

• Microbiological – bacteria
  • *Salmonella*,
  • *Campylobactercoli*,
  • *Listeria monocytogenes*,
  • *Escherichia coli*
• Technological - extensive biotechnology literature
• Chemical (residues)–
  • agri-chemicals,
  • growth control hormones,
  • feed conversion enhancers
  • anti-biotic treatments
• contaminations,
• ‘additives’, ‘preservatives’
Approaching consumers as consumers

- Presenting food products (purported to be) containing the ‘risk’
- Using choice modeling (or conjoint)
- Testing for possible segmentation—
  - ‘acceptors’;
  - ‘indifferents’
  - ‘rejectors’
- Using psychological variables (values and attitudes) to understand segments
- Using values and attitudes for tailored communication strategies
New approaches: Values, beliefs, group norms

• ‘Theory of cultural cognition’ as an explanation of risk perception (Kahan, 2010, Kahan et al., 2007).
• The theory draws upon two theories:
  • 1) the cultural theory of risk
  • 2) Identity-protective cognition (Kahan et al, 2007) or group identity
• Wide application in USA
  • gun control,
  • abortion,
  • vaccination,
  • biotechnology
• no application to food risk
  • No examples outside USA
Cultural theory of risk

• Appealing to people’s cultural values (and group norms) may be the new paradigm for understanding and communication.
• Derived from anthropology (Purity and Danger, Mary Douglas, 1966, revised 2002)
Identity-protective cognition (Kahan et al, 2007) or group identity

• People’s identity and well being can be challenged when an issue conflicts with their groups’ beliefs (Cohen, Aronson & Steele, 2000).

• These perspectives extend to the sources of information pertaining to the product.

• Trust and credibility are established as being important when communicating non-tangible (credence) product attributes

• however there is emerging evidence that different sources of information (sources in line with self identity) appeal to those of differing world views and values

• Has implications for targeted communication strategies
How does this apply to food risk?

- Food is ingested and may also prompt affective reactions (sensory-hedonics and emotions).
- Example of a current study.
- Recycled water in food production
- Challenges / tensions
  - environmental benefit
  - industry resource efficiency
  - negative affect: disgust (dread)
- perceptions of risk of technology and contamination
Why is water an issue?
The driest inhabited continent

- Water utilities
- Water stress
Recycled water in food production

FOOD AND HEALTH/WATER FOR HEALTHY COUNTRY FLAGSHIP

Opportunities for using recycled water in sustainable food production

- Economics (reducing the cost of fertilisers)
- Environmental benefits
- Improving process efficiencies
- Process validation
- Technology developments
- Economics (cost vs benefits)
- Competitive advantages
- Environmental benefits
- Consumer perceptions
- Consumer behaviour
- Technologies for nutrient recovery

Agriculture → Manufacturing → Consumer

Waste treatment → Nutrient recovery → Recycled water

Municipal waste treatment → Recycled water

Systems integration
- Food Miles
- Local vs central production
- Value proposition
- Barriers (economic, regulatory, marketing, social)
- Challenges
- Scenario analysis (e.g. impact of high costs of fertiliser, water, energy etc.)
The issue: recycled water in food production

- Australian food processing industry uses 215 GL/annum
- Could re-use 33 GL/annum or 15% (DAFF, 2010).
- 76% of food industry respondents identified future opportunities for greater water recycling within 5 years,
  - 20% of current potable water intake.
- Management and disposal of “waste” water
  - expensive
  - negative environmental impact.
- Recycled water = recycled within a food plant (not recycled municipal water)
- Fear of a consumer backlash (perceived risk)
- Negative reports from potable water recycling (Po et al, 2005; Marks et al., 2006; Dolnicar, 2000): perceived risk
Risk characteristics and the current example

- severity of consequences,
- control over risk,
- immediacy of effect,
- voluntariness of risk,
- knowledge about risk,
- newness,
- chronic-catastrophic,
- common-dread
- Unknown
- Extent of society’s exposure
- trust

- Perceived acute illness
- Limited control
- Short and long term
- Not voluntary
- Limited knowledge
- Novel (in Australia)
- Widespread population effect
- Disgust
- Long term ingestion unknown
- Widespread
- Not varied in this study
The perceived risk of recycled water in food

• **Aims**
  • test a meat product (meatballs).
  • Determine the acceptance of meatballs purported to be manufactured using differing applications of recycled water (proximity to ingestion).
  • Identify segments of consumers, by their personal characteristics, values and attitudes

• **Objectives**
  • 200 consumers representative of the Australia population.
  • Undertake a Choice experiment (n = 200),
    – test willingness to pay for recycled water in food production varying by proximity to ingestion.
  • To split this sample into two groups
    – test for the affects of tasting (n = 100)
      – Hedonics (Disliking - Liking);
      – Emotions (Desmet & Schifferstein, 2008),
  • Test hypothetical bias: participants choices are linked to what they taste - “eat your choice” (n = 100)
  • Seek relationships with
    – Values (Kahan et al, 2007);
    – Environmental attitudes (Ryan & Spash, in press)
    – Food Technology Neophobia (Cox & Evans, 2010)
Hypotheses and research questions

• The closer the recycled water is to ingestion, the greater the negative emotions evoked and the less liked a product will be rated.
  • This was tested by asking consumers to taste food (meatballs) purported to be manufactured or containing recycled water.

• The closer recycled water is to ingestion, the lower the willingness to pay.
  • This will be tested by varying the use of recycled water in a food production system (from ‘plant cleaning’ to ‘as an ingredient’).

• Asking participants to taste their choices will reduce the potential for hypothetical bias relative to survey choice responses.

• Exposure (tasting) to products purported to be made or processed with recycled water will influence choice of products purported to be made or processed with recycled water.

• Neophobia will be associated with choice of non-recycled water options.

• Communitarian and egalitarian values will be associated with choice of recycled water options.

• Pro-environmental attitudes will be associated with choice of recycled water options.
## Range of meatball attributes

| Type of Beef                  | 2 levels | Classic Beef ¹  
|------------------------------|---------|-----------------  
|                              |         | Angus Beef      ²  
| Meat Fat Content             | 3 levels| Regular (15% fat) ², Lean (10%), Extra Lean (5%)  
| Water used                   | 4 levels| • Tap Water Used throughout,  
|                              |         | • Recycled water used to clean the floors,  
|                              |         | • Recycled water used to clean equipment,  
|                              |         | • Recycled water used as an ingredient  
| Price                        | 8 levels| $3.00, $3.75, $4.50, $5.25, $6.00, $6.75, $7.50, $8.25  

¹ Classic beef is all other breeds of cattle and not a premium product – it is not a brand as such. Angus beef is a breed of cow generally associated with higher quality.  
² Qualitative labels and were defined in the glossary provided to participants in terms of proportion of fat in meat
A choice set (1 of 16) as presented to consumers (n = 203)

<table>
<thead>
<tr>
<th>Features of Meatballs</th>
<th>Package A</th>
<th>Package B</th>
<th>Package C</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type of Beef</td>
<td>Angus Beef</td>
<td>Regular Beef</td>
<td>Angus Beef</td>
</tr>
<tr>
<td>Meat Fat Content</td>
<td>Lean</td>
<td>Extra Lean</td>
<td>Regular</td>
</tr>
<tr>
<td>Water used</td>
<td>Recycled water used as an ingredient</td>
<td>Recycled water used to clean equipment</td>
<td>Recycled water used to clean the floors</td>
</tr>
<tr>
<td>Price</td>
<td>$8.75</td>
<td>$3.50</td>
<td>$5.00</td>
</tr>
</tbody>
</table>

I would be **MOST** likely to buy (tick one)

- Package A
- Package B
- Package C

Spend your money on something else/keep looking

I would be **LEAST** likely to buy (tick one)

- Package A
- Package B
- Package C
### Simple Multinomial Logit Model of choice (n = 203)

<table>
<thead>
<tr>
<th>Relative to</th>
<th>Coefficient</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Constant for left hand side choice</td>
<td>0.018212</td>
<td></td>
</tr>
<tr>
<td>Constant for middle choice</td>
<td>0.113921 **</td>
<td></td>
</tr>
<tr>
<td><strong>Classic</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Beef angus</td>
<td>0.570175 **</td>
<td></td>
</tr>
<tr>
<td><strong>Regular</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fat level – lean</td>
<td>-0.47077 **</td>
<td></td>
</tr>
<tr>
<td><strong>regular</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fat level - extra lean</td>
<td>0.190375 **</td>
<td></td>
</tr>
<tr>
<td><strong>Tap water</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Recycled water - used on floor</td>
<td>0.454727 **</td>
<td></td>
</tr>
<tr>
<td><strong>Tap water</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Recycled water - used on equipment</td>
<td>-0.18978 *</td>
<td></td>
</tr>
<tr>
<td><strong>Tap water</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Recycled water - used as an ingredient</td>
<td>0.064275 *</td>
<td></td>
</tr>
<tr>
<td><strong>Price</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>-0.21557 **</td>
<td></td>
</tr>
</tbody>
</table>

* P <0.05; ** p< 0.01
### Willingness to pay (n = 203)

<table>
<thead>
<tr>
<th>Item</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>Beef - Angus</td>
<td>$2.65</td>
</tr>
<tr>
<td>Fat level - lean</td>
<td>-$2.18</td>
</tr>
<tr>
<td>Fat level - extra lean</td>
<td>$0.88</td>
</tr>
<tr>
<td>Recycled water used on floor</td>
<td>$2.11</td>
</tr>
<tr>
<td>Recycled water used on equipment</td>
<td>-$0.88</td>
</tr>
<tr>
<td>Recycled water used as an ingredient</td>
<td>$0.30</td>
</tr>
</tbody>
</table>
Affective responses: hedonics and emotions

• N = 101
• All meatball attributes other than proximity to ingestion were held constant (i.e. Lean, Angus beef, $5/kg),
• while recycled water proximity to ingestion varied
  • Sample A = recycled water as an ingredient;
  • Sample B = recycled water used to clean equipment;
  • Sample C = Recycled water used to clean floors; and
  • Sample D = Tap water used for all purposes (as a reference product).
• randomised presentation to minimise first order and carry-over effects.
Hedonics and emotion scores

<table>
<thead>
<tr>
<th>Sample (A): Recycled water used as an ingredient</th>
<th>Sample (B): Recycled water used to clean equipment</th>
<th>Sample (C): Recycled water used to clean the floors</th>
<th>Sample (D): Tap water used for all purposes</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>M</strong></td>
<td><strong>SE</strong></td>
<td><strong>M</strong></td>
<td><strong>SE</strong></td>
</tr>
<tr>
<td>Hedonics</td>
<td>7.01$^a$</td>
<td>0.13</td>
<td>6.95$^a$</td>
</tr>
<tr>
<td>Associated emotions</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Satisfaction</td>
<td>3.30$^a$</td>
<td>.090</td>
<td>3.31$^a$</td>
</tr>
<tr>
<td>Enjoyment</td>
<td>3.17$^a$</td>
<td>.104</td>
<td>3.00$^a$</td>
</tr>
<tr>
<td>Pleasant Surprise</td>
<td>2.51$^a$</td>
<td>.123</td>
<td>2.27$^a$</td>
</tr>
<tr>
<td>Boredom</td>
<td>NS</td>
<td>NS</td>
<td>NS</td>
</tr>
<tr>
<td>Disappointment</td>
<td>1.64$^a$</td>
<td>.108</td>
<td>1.26$^b$</td>
</tr>
<tr>
<td>Dissatisfaction</td>
<td>1.54$^a$</td>
<td>.098</td>
<td>1.28$^b$</td>
</tr>
<tr>
<td>Boredom</td>
<td>1.51$^a$</td>
<td>.090</td>
<td>1.29$^b$</td>
</tr>
<tr>
<td>Contempt</td>
<td>1.33$^a$</td>
<td>.075</td>
<td>1.28$^{bc}$</td>
</tr>
<tr>
<td>Unpleasant Surprise</td>
<td>1.31$^a$</td>
<td>.071</td>
<td>1.17$^a$</td>
</tr>
<tr>
<td>Disgust</td>
<td>1.18$^a$</td>
<td>.058</td>
<td>1.15$^a$</td>
</tr>
<tr>
<td>Fear</td>
<td>1.11$^a$</td>
<td>.045</td>
<td>1.05$^a$</td>
</tr>
</tbody>
</table>

Emotional Score (1 = Not at all to 5 = Strongly)

- Sample (A): Recycled water used as an ingredient
- Sample (B): Recycled water used to clean equipment
- Sample (C): Recycled water used to clean the floors
- Sample (D): Tap water used for all purposes
Preliminary conclusions

• Preliminary results suggest no evidence for a negative linear response to recycled water proximity to ingestion; however, further testing is required.

• Within the context of a laboratory test (by a trusted institution) there was little evidence of negative affective responses to recycled water proximity to ingestion.

  • = Liking
  • = Emotions
  • + emotions

• More analysis required
  – Individualistic values inversely correlated with BSEA, r = -.43, p=0.000
  – Hierarchical values inversely correlated with BSEA, r= -.26, p=0.01
General approaches to food risk

- Depends on how you ask the questions
- Economics, Psychology, Sensory and Consumer sciences
- Treating people as consumers not citizens
- Bottom-up not top-down judgments
- Experience not hypothetical scenarios
- Choice modeling could be useful
- Affective measures (tasting, liking and emotions) suggest positive reactions
- As in reactions to potable water (Po et al, 2006); food technology risk domain (Frewer et al, 1996; Grunert et al, 2004; Lahteenmaki et al, 2002).
- Limitations: trusted institution as a context for consumption
Thank you

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