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Consumer concerns and expectations about novel food processing technologies: effects on product liking ☆

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Abstract

Eighty-eight consumers participated in a blind pre-test in which they rated their baseline preference for chocolate pudding, their liking of three tasted brands of chocolate pudding, and their level of concern for 20 different food processing and preservation technologies. All returned one month later and tasted the same puddings, but this time they were informed that they had been processed by one of several different novel or traditional food processing techniques. Different sub-groups were informed of the name of the process, the name plus a factual description of the process, or the name, the factual description, plus a benefit statement. Ratings of expected liking were obtained before and after viewing the samples, but before tasting them. Finally, subjects tasted and rated the products for actual liking and a sub-group rated their concern levels for the same 20 technologies rated in the pre-test.

Pre-test results showed females to have significantly higher concern levels for all technologies. Individuals who had demonstrated a willingness to consume foods processed by one novel technology (irradiation) had lower concern ratings for all technologies. Ratings of concern were negatively correlated with expected liking for products believed to be processed by the technologies. Expected liking ratings were positively influenced by visual exposure to the product and by a safety and benefit statement. Linear regression of the change in product liking as a function of whether products were better or worse than expected supported an assimilation model of the effect of disconfirmed expectations on liking/disliking. Lastly, post-test concern levels for many of the technologies were reduced by participation in the study.
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Keywords: Consumer concerns; Expectations; Novel food Processes

Introduction

The US Army Natick Soldier Center (Natick Labs) in Natick, MA has been on the forefront of the development of novel food processing and preservation techniques for use in military rations for the past 40 years. Many of these technologies and the foods resulting from them have found their way to the commercial marketplace. Early research on freeze-drying, compression, chemical and biological preservatives, and flexible packaging has evolved into cutting-edge research on a variety of novel and emerging food processes. Among these are a number of thermal and non-thermal processing methods that utilize irradiation, pulsed electric fields, ultra-high pressure, ohmic heating, microwave processing, and radio-frequency heating, often in combination with other 'hurdle' technologies, to preserve foods (Taub, 1999). All of these technologies are designed to produce foods and rations that have high sensory quality and consumer acceptance while meeting the rigorous logistical and shelf-life standards for military combat use. Much of this research is being conducted in collaboration with academic and industry researchers with the 'dual-use' goal of applying these emerging technologies to commercial food practice (Dunne, 1999).

Supporting these research and development activities is a well-established and long-standing program of research on sensory analysis and consumer acceptance of foods (see Meiselman & Schutz, 2003 for an historical review of this area at Natick). A critical focus of recent research in the latter area has been the study of the intrinsic and extrinsic factors that influence consumer acceptance of both conventional and novel foods, including the role of sensory,

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cognitive, and situational variables (e.g. Cardello, 1996; Cardello, Bell, & Kramer, 1996; Cardello & Schutz, 1996; Cardello, Schutz, Snow, & Lesher, 2000; Hirsch & Kramer, 1993; Kramer, Edinberg, Luther, & Engell, 1989; Meiselman, 1992; Meiselman, Hirsch, & Popper, 1988; Tuorila, Cardello, & Lesher, 1994a; Tuorila, Meiselman, Bell, Cardello, & Johnson, 1994b). This convergence of research on novel foods and food processes and the effects of sensory, cognitive, and situational variables on food acceptance has led to an examination of civilian and military consumer attitudes toward novel foods and food processes and the effect of information on changing attitudes toward them (Cardello, 2000; Cardello, Maller, Bloom-Masor, Dubose, & Edelman, 1985; Salo, 1998; Schutz & Cardello, 1997; Tuorila et al., 1994a; Tuorila et al., 1994b). Although these studies and others in the literature (Bruhn, Schutz, & Sommer, 1986; Frewer, Howard, Hedderley, & Shepherd, 1997a; Frewer, Howard, & Shepherd, 1997b; Frewer & Shepherd, 1995; Frewer, Shepherd, & Sparks, 1994; Gallup, 1993; Schutz, Bruhn, & Diaz-Knauf, 1989; Titlebaum, Dubin, & Doyle, 1983; Bruhn, 1996; Bredahl, 1999; da Costa, Deliza, Rosenthal, Hedderley, & Frewer, 2001; Grunert et al., 2001; Hoban & Katic, 1998; Tuorila, Andersson, Martikainen & Salovaara, 1998; Schutz & Cardello, 1997) have examined consumer attitudes and concerns toward novel food technologies, none have attempted to relate these attitudes and concerns to the cognitive expectations that consumers have regarding the sensory and hedonic characteristics of foods (Cardello, 1994; Deliza & MacFie, 1996). This is the case, in spite of the fact that such expectations have been shown to be important drivers of the liking/disliking of tasted products.

Novel food technologies and consumer risk perception

Foods processed by novel and emerging food technologies, e.g. biotechnology, ionizing radiation, pulsed electric fields, ultraviolet laser treatment, etc. pose challenging problems for researchers interested in the factors responsible for consumer choice, purchase behavior, and acceptance of these foods. Like most food products, optimizing the sensory quality of these foods is critical to their success in the market place. However, optimal sensory quality, on its own, will not guarantee success. The reason for this is that consumer perceptions of food quality do not depend solely on the intrinsic sensory characteristics of the product. Rather, they rely heavily on a host of factors that are extrinsic to the product. These extrinsic factors include contextual, cognitive, social, cultural and attitudinal variables related to both the product and the prospective consumer of the product. In the case of novel foods or foods that have been processed by novel or emerging technologies, concerns about the nature of the food and/or the nature of the processing technologies that have been used to treat the food become paramount considerations for the consumer faced with choice and purchase decisions.

Over the past several years, numerous investigators have assessed the concerns of consumers toward a variety of novel food technologies and other food-related safety issues (Bord & O'Conner, 1990; Bredahl, 1999; Brewer, Sprouls, & Russon, 1994; Bruhn, 1995a; Bruhn et al., 1996; Bruhn, Schutz, & Sommer, 1987; Da Costa et al., 2001; Dunlap & Beus, 1992; Frewer et al., 1997a; Frewer et al., 1997b; Frewer & Shepherd, 1995; Frewer et al., 1994; Grunert et al., 2001; Moseley, 1990; Schutz et al., 1989; Schutz & Cardello, 1997; Sheehy, Legault, & Ireland, 1998; Sparks & Shepherd, 1991; Verbeke, 2001; Wolf, 1992). Much of this research has been undertaken within the context of the normative/value model of perceived risk (Fischoff, Slovic, Lichenstein, Read, & Combs, 1978; Slovic, Fischoff, & Lichtenstein, 1979). This model defines risk as a perceptual construct that must be evaluated by lay persons on the basis of subjective evaluations. It stands in opposition to the technical/rational model that bases the evaluation of risk on actuarial data and the opinions of scientists or industry experts (Fischoff, Slovic, & Lichtenstein, 1982). The normative/value model has gained much attention during the past decade due to the realization that consumers often have considerable levels of concern about hazards that have been shown to have relatively low risk from an objective, i.e. technical/rational, risk analysis standpoint. As suggested by Krause, Malmfors, and Slovic. (1992), human beings are 'intuitive toxicologists' when it comes to assessing the risks from environmental hazards.

Research on the normative/value model of risk has identified a variety of factors that characterize consumer perceptions of risk (Slovic, 1987; Slovic, Fischoff, & Lichtenstein, 1985). Among these are whether the risk is voluntary or involuntary, immediate or delayed, observable or unseen, fatal or non-fatal, the degree to which the risk is known to science, and the degree of control that consumers have over the risk. With regard to food-related risks, Oser (1978) identified the voluntary-involuntary nature of the risk as an important element influencing consumer concerns, while Sparks and Shepherd (1994) have identified a variety of general and more specific characteristics of food-related risks that are important to the understanding of consumer risk perceptions. Within this context, the application of novel food processing technologies to commercial foods creates high levels of consumer concern. This is because the risk associated with these technologies possess many of the characteristics that engender the greatest concern among consumers—they are often involuntary risks, because the consumer is not always aware of the processes applied to purchased foods; they are generally out of the control of the consumer, because once applied, they cannot be reversed; they are typically unobservable, having been applied to the food or its ingredients at an early stage of processing; and they often have unknown, delayed, and potentially fatal (in the eyes of some consumers) health effects.

Other factors that have commonly been examined for their influence on consumer risk perceptions are those related to the individual. For example, it has been shown that certain groups of individuals are predisposed to accept or reject technological change. In the case of food-related risks, 'green' or 'alternative' consumers, such as those who shop in food co-operatives, have been shown to be resistant to technological change (Bruhn et al., 1986) and to express greater concern about novel food technologies (Bruhn et al., 1996). On the other hand, consumers who show trust in the food industry, in government regulatory agencies, and in science have been shown to be much more accepting of foods processed by such technologies (Bord and O'Conner, 1990). Lastly, a demonstrated willingness to taste and/or consume foods processed by a novel technology, i.e. irradiation, has been proposed to be an important behavioral predictor or 'proxy' of the perceived safety of these foods (Terry & Tabor, 1990).

The effect of the perceived risks of novel food technologies in the marketplace can be most readily seen in the on-going research and controversy over irradiated and genetically modified foods (Grunert et al., 2001; Saba & Vassallo, 2002; Wheelwright, 2001; Wolf, 1992; Allen, 1999; Cheney, 1993; Doyle, 2000; Enserink, 1999; Erickson, 1992; Heijs, Midden, & Drabbe, 1993; Kaufman, 2000; Otto, 1999; Rousseau, 1997; Weiss, 1999; Zechendorf, 1994; Hamstra, 1993). While these technologies garner the most attention, both in the public's eye and in terms of research attention, a wide variety of other, seemingly less hazardous food technologies have the potential to engender perceptions of risk and associated concern that may override the potential benefits of these processes and impede the market introduction of products that utilize these technologies. These include the wide variety of high-potential thermal and non-thermal technologies currently under development at Natick and other major food science laboratories.

In the effort to counteract the effect of negative risk perceptions about novel food technologies on food choice, acceptance and purchase behavior, food industry researchers have focused much of their attention and effort on public education and other information-based approaches (Bruhn, 1995b; Hashim, Resurreccion, & McWatters, 1996; Mossel & Drake, 1990; Pohlman, Wood, & Mason, 1994). These information-based approaches are well supported by a variety of studies showing that both intrinsic and extrinsic product information, such as product names, brands, labels, packaging, nutrition and other information can have a dramatic effect on product identification, preference, perceived sensory and image attributes, acceptance, intended purchase, and consumption (Bell & Paniesin, 1992; Bruhn et al., 1986; Kahkonen, Hakanpaa, & Tuorila, 1999; Kahkonen, Tuorila, & Rita, 1996; Kalick, 1992; Kramer et al., 1989; Rozin, Markwith, & Ross, 1990; Schutz and Cardello, 1997; Cardello et al., 1996; Cardello et al., 1985; Cardello & Sawyer, 1992; Johansson, Haglund, Berglund, Lea, & Risvik, 1999; Lange, Rousseau, & Issanchou, 1999; Schifferstein, Kole, & Mojet, 1999; Scharf & Volkmer, 2000; Tuorila et al., 1994a). In particular, information concerning either the safety or benefits of novel food processes has been shown to have a positive influence on acceptance and likelihood of purchase of foods exposed to these processes (Bruhn, 1995a; Frewer et al., 1997a; Frewer, Howard, & Shepherd, 1996; Schutz et al., 1989). These influences of information on consumer product perceptions and behavior are often referred to as 'framing' effects, because they are sensitive to the specific context and wording of the information presented to the consumer (Kahneman & Tversky, 1974; Tversky & Kahneman, 1984). Although many studies have taken a practical approach to the study of framing effects by manipulating information believed to be relevant to product acceptance and then examining the effect of the manipulation on consumer attitudes or behavior, far fewer studies have sought to elucidate the mechanism by which these information effects operate.

One general set of models that have been applied to the understanding of the possible mechanisms mediating information effects are expectancy-value models. These cognitive models of attitude change ascribe critical importance to the psychological construct of expectancy and its confirmation or disconfirmation in the explanation of changes in attitudes and subsequent behavior toward a variety of stimulus conditions. A growing number of these studies have applied the construct of disconfirmed expectations as an explanatory mechanism to account for the effects of product names, labels, brands, and other extrinsic information on consumer attitudes and behavior toward food. The application of these models and their predictions for consumer food attitudes and behavior has been reviewed by Cardello (1994); Cardello (1995) and by Deliza & MacFie (1996).

Over the past 25 years, the bulk of empirical research on the role of disconfirmed expectations on the sensory and hedonic aspects of products has supported an assimilation model (Sherif & Hovland, 1961) of these effects (Anderson, 1973; Bearden & Teel, 1983; Cardello et al., 1996; Cardello & Sawyer, 1992; Helleman, Aaron, Evans, & Mela, 1993; Lange et al., 1999; Oliver, 1977; Olshavsky & Miller, 1972; Olson & Dover, 1976; Schifferstein et al., 1999; Tuorila et al., 1994a). The assimilation model predicts that when expectations are high but intrinsic quality is low (a state of negative disconfirmation), perceived acceptability will assimilate the (higher) level of the expectation and result in increased liking. Alternatively, if expectations are low but intrinsic quality is high (a state of positive disconfirmation), perceived acceptability will assimilate the lower expectation and liking will decrease.

The implications of the assimilation model for foods processed by novel and emerging food technologies are two-fold. First, on the negative side, if consumer expectations for these foods are low (regardless of cause), the assimilation model predicts that liking of these products will suffer. Given consumers' documented concerns about consuming foods processed by many novel and emerging food technologies, it is important to determine whether such concerns are also associated with lower expected liking/disliking of the product, because the assimilation model predicts that such lowered expectations will also lower liking of the tasted product. On the positive side, though, if product expectations can be raised by information that minimizes the risk perceptions or concerns associated with the product, the assimilation model predicts that liking will increase.

With the above theoretical context in mind, research was undertaken with the following goals:

1. Determine the level of concern among consumers for a variety of conventional and novel, thermal and non-thermal food processing techniques.
2. Assess consumers' expected and actual liking/disliking for a food product in a control condition and in one or more information (framing) conditions, where consumers are led to believe that the product is processed by one of these food processing techniques.
3. Assess the relationship between concern levels for the technology and ratings of expected liking/disliking.
4. Assess the effects of framing information, gender, and the 'food risk tendencies' of consumers on expected liking/disliking.
5. Assess the effect of expectations on actual product liking within the context of theories of the effect of disconfirmed expectations on product acceptance.
6. Assess the role of product exposure, factual information, and safety/benefit statements in reducing concern and/or expected liking for novel food processing techniques.

Methods

Subjects

Subjects consisted of 88 (58M/30F) individuals selected from a group of 275 employees at the US Army Natick Soldier Center, Natick, MA, who had volunteered to participate in routine consumer tests of foods. All were residents of the northeastern United States and ranged in age from 18 to 64. Selection criteria included the requirement that their work did not involve food science or food product development activities. In order to test the hypothesis that individuals with a behaviorally demonstrated willingness to taste and consume foods processed by one novel or potentially 'risky' technology may have less concern for a variety of such technologies, subjects were selected from among two sub-groups of volunteers. Both sub-groups had equivalent experience in the number and nature of the sensory consumer tests in which they had participated. The only difference between the sub-groups was whether or not the individuals had previously volunteered to test irradiated foods as part of routine taste tests conducted in the laboratory. Using a quasi-random selection procedure from these two sub-groups that maintained the approximate ratio of males to females in the overall panel, the final test population consisted of 46 subjects who had previously volunteered to test irradiated foods and 42 who had not.

Procedure

Subjects participated in one or more of three different experimental sessions. All subjects participated in a baseline session in which they rated their general preference for chocolate pudding, i.e. liking/disliking in response to the words 'chocolate pudding' (no product or information presented) (see Cardello et al. (2000) for a discussion of the use of the word 'preference' in these situations) and their liking/disliking for three different commercial chocolate puddings (products tasted, but no other product information presented). The products tested were three different brands of chocolate pudding (Hunt's (Conagra Grocery Products Co., Fullerton, CA), Jell-O (Kraft Foods, Inc., Dist: Rye Brook, NY) and Swiss Miss (Conagra Grocery Products Co., Irvine, CA)). Different brands were used in order to introduce sensory variety and apparent face validity to subsequent experimental manipulations in which subjects would be told that the chocolate puddings had been treated by different food processing techniques.

Fifty grams of chocolate pudding were presented at room temperature in white serving bowls with a plastic spoon. Samples were presented in random order and subjects were instructed to rinse with bottled water between samples. A 60 s ISI was maintained. All ratings were made on a 9-point hedonic scale (Peryam & Pilgrim, 1957) using SIMS 2000 data capture software. After tasting and rating the three puddings, subjects rated their concern levels for 20 different conventional and novel food processing technologies (see Figs. 1–3) using a 5-point rating scale (1 = 'not at all concerned, 5 = 'extremely concerned', with an 'uncertain' response option).

Approximately 3–6 weeks after the baseline session, depending upon subject availability, subjects were asked to return to the laboratory to participate in subsequent 'taste test(s)' of chocolate pudding. Half of the subjects returned for a single session, while the other half returned for two sessions scheduled one week apart. Subjects in these sessions were unaware that the samples to be tested were the same as those tested previously in the baseline session. In all sessions after the baseline session, subjects tasted and rated six samples, two replicates of each of the three brands of pudding tasted in the baseline session. The order of the six samples was randomized in the first post-baseline session, but quasi-randomized in the second of these sessions due to design considerations (see below). All conditions of sample preparation, presentation, and testing were the same as in the baseline session, except that subjects were provided information about how the chocolate

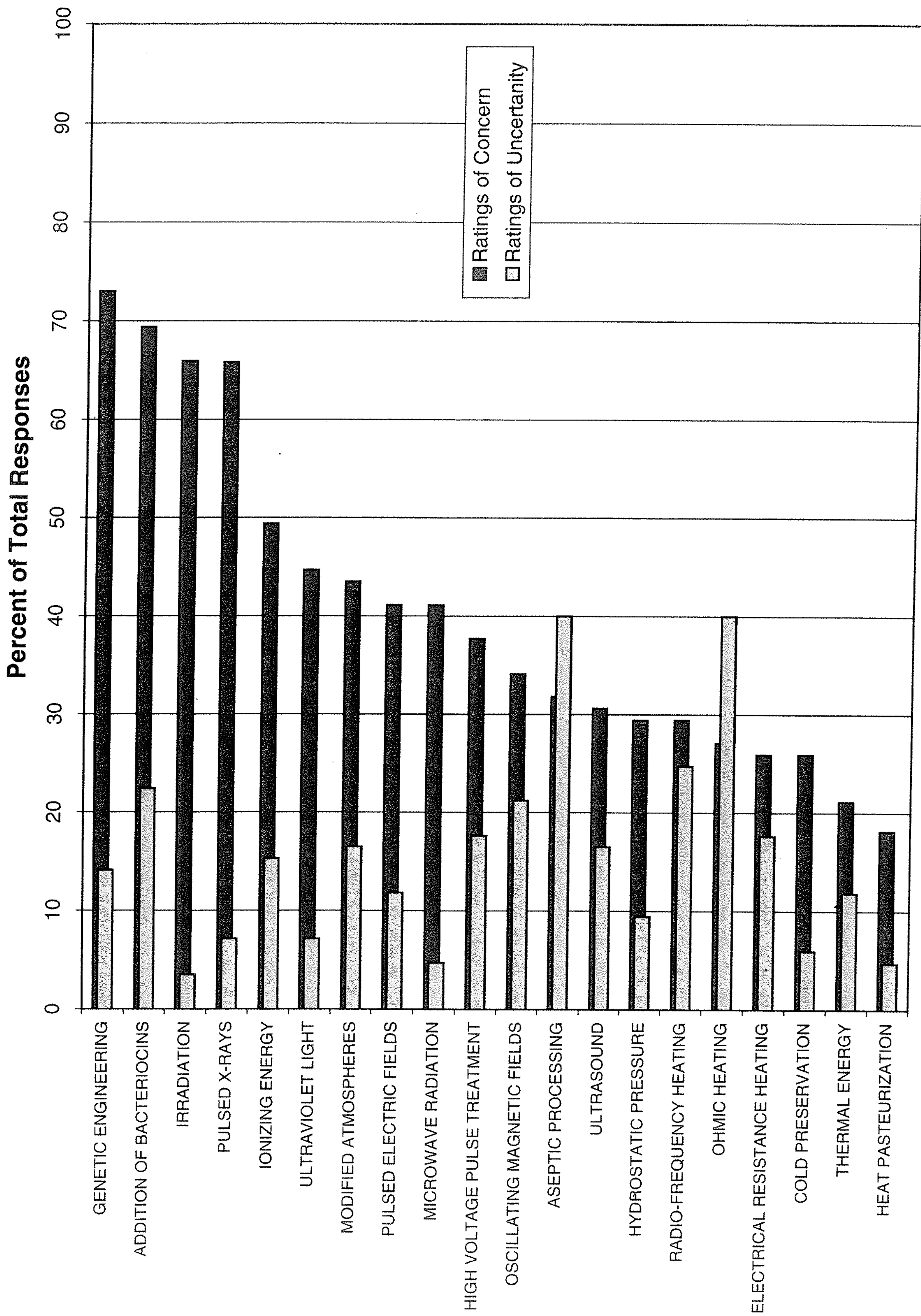

Fig. 1. Percentage of subjects reporting some degree of concern ('slight', 'moderate' or 'extreme') and the percentage of 'uncertain' responses for the 20 different food processing technologies surveyed in the baseline session.

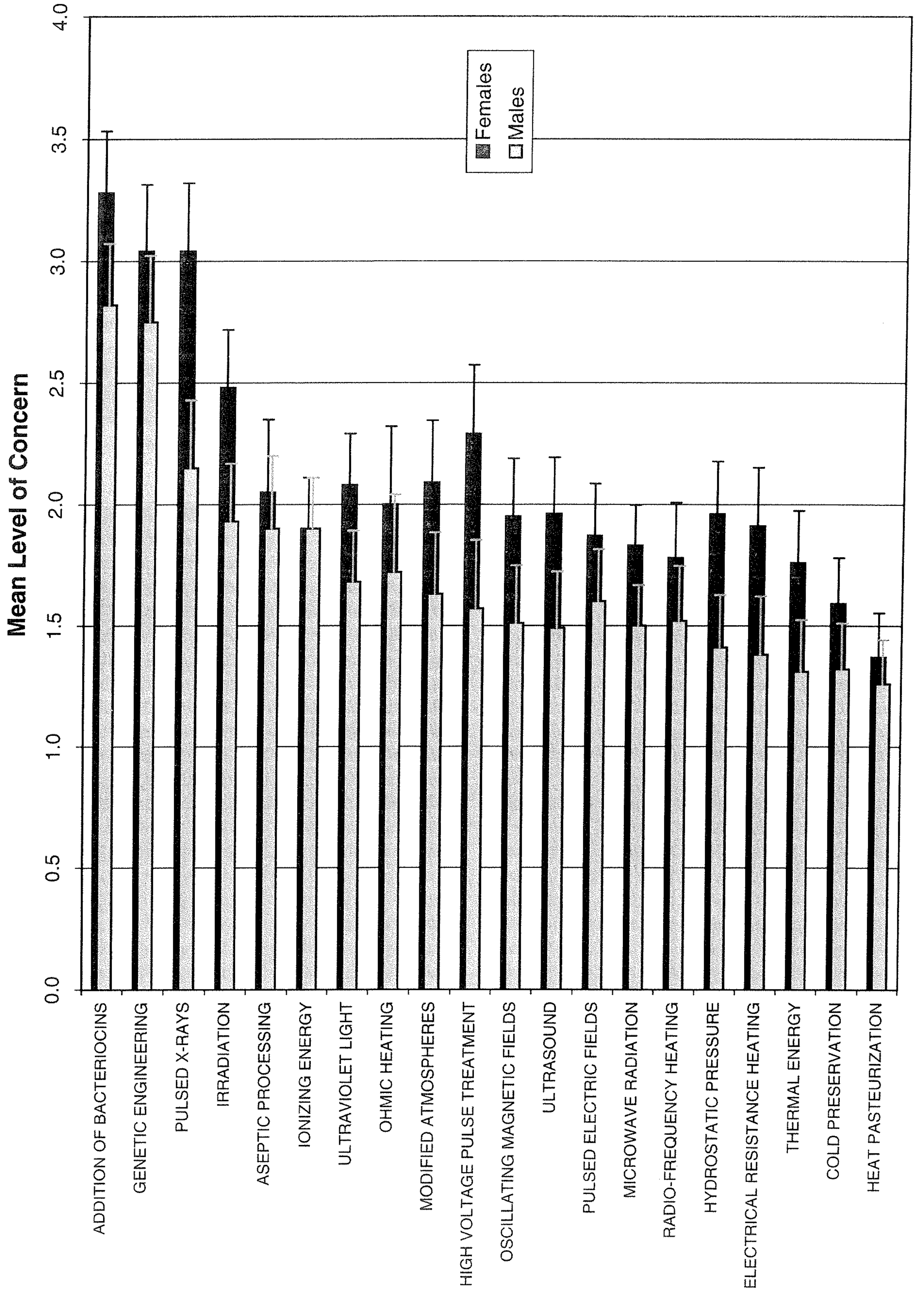

Fig. 2. Mean and standard error of concern ratings by gender.

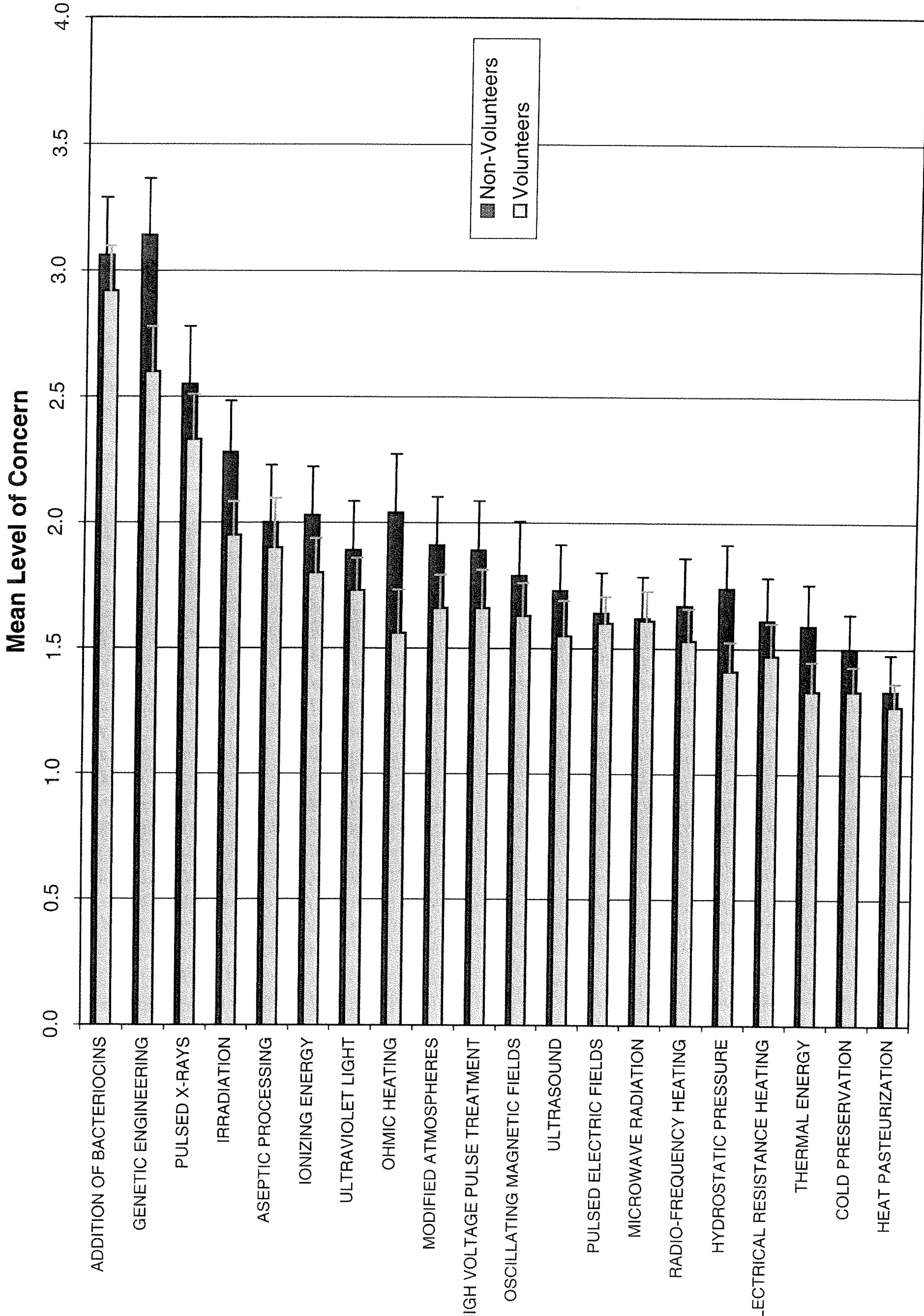

Fig. 3. Mean and standard error of concern ratings for consumers who had previously volunteered or not volunteered to consume irradiated foods.

puddings had been processed. Half of the subjects ($n = 42$) who returned for only a single session (Name Only Condition) were told only that they would be tasting six chocolate puddings that had each been treated using a different food processing technique, e.g. 'this sample was processed by pulsed electric fields'. No information other than the name of the technology was provided. The technology names used in this condition were 'heat pasteurization', 'irradiation', 'high voltage pulses', 'pulsed electric fields', 'cold preservation', and 'the addition of bacteriocins.' The technology names were selected on the basis of an analysis of the mean concern ratings for the various technologies obtained in the baseline session. Technologies were chosen so as to span a wide range of concern levels (see Figs. 1–3) and to include processes of interest to in-house research and development programs. Each technology name was paired equally often with the three different brands of pudding across subjects.

The other half of the subjects ($n = 46$) returned for two sessions. They were provided information that included either (1) the name of the technology and an objective description of that technology, e.g. 'in irradiation processing, foods are exposed to a source of ionizing radiation, e.g. cobalt 60, for short periods of time' (Name + Description Condition) or (2) the name of the technology, a description of it, and a statement about its safety and benefits (Name + Description + Benefit Condition). Of the 12 samples tasted by these subjects during the two test sessions, the first eight samples (all six samples in the first of the two sessions and the first two samples in the second of the two sessions) were accompanied with information about the name of the technology and its description (Name + Description). The technology names and their descriptions appear in Table 1. Of these, the first five technology names were the same as those used in the Name Only Condition.

Table 1
Technology names and descriptions used in the various test conditions

Pulsed electric fields—In pulsed electric field processing, pulses of high intensity electric fields (10,000–30,000 volts) are passed through the food.
Irradiation—In irradiation processing, foods are exposed to a source of ionizing radiation, e.g. cobalt 60, for short periods of time.
Bacteriocins—In processing with bacteriocins, proteins produced by bacteria, e.g. lactic acid bacteria, are added to the food during processing.
High voltage pulses—In high voltage pulse processing, pulses of high intensity electric fields (10,000–30,000 volts) are passed through the food.
Heat pasteurization—In heat pasteurization, foods are exposed to temperatures of 240–250°F, often using condensing steam in a pressurized vessel.
Non-thermal preservation—In non-thermal processing, foods are exposed to processes that do not raise the food to high temperatures, e.g. pulsed fields, high-energy light, or hydrostatic pressure.
Hydrostatic pressure—In hydrostatic pressure processing, extremely high pressures (>75,000 psi) are applied to the food.
Pulsed light—In pulsed light processing, foods are exposed to pulses of light in the visible, ultraviolet, and near infrared parts of the electromagnetic spectrum. These pulses are about 20,000 times more intense than sunlight.

'Cold preservation', which was the sixth technology name used in the Name Only Condition, was dropped from further testing, because post-test interviews with subjects in the Name Only Condition indicated that they interpreted the term to mean preservation by refrigeration, rather than its technical meaning of preservation by 'non-thermal' food processing methods. In its place, the term 'non-thermal preservation' was added along with its accompanying definition. In addition, two additional non-thermal processing methods, 'hydrostatic pressure' and 'pulsed light', were included. The last four samples presented in the second session for these subjects were accompanied with information about the name of the technology, its description, plus a benefit statement that read: 'this process is entirely safe and avoids the thermal damage done to foods by heat pasteurization' (Name + Description + Benefit Condition). The technology names and descriptions used with these samples were the first four technologies listed in Table 1. In all test sessions and conditions where the same technology name was used (regardless of other information presented) that technology name was always paired with the same brand of chocolate pudding, so that comparisons could be made among all test and baseline sessions.

Regardless of information condition, after subjects were exposed to the framing information, they were instructed to rate their expected liking/disliking of the chocolate pudding prior to receiving the test sample. Subjects made these judgments of expected liking/disliking using the same nine-point hedonic scale used to make their preference and liking/disliking judgments in the baseline session. After making this first expectation judgment, subjects were presented the sample and instructed to visually examine it. Then, before tasting it, they were asked to rate their expected liking/disliking of the sample again. After making this second expectation judgment, subjects tasted the sample and rated it for liking/disliking, as in the baseline session.

For those subjects participating in the Name + Description Condition and the Name + Description + Benefit Condition, after completing their evaluation of the products in the second of the two test sessions, they again rated their concern levels for the 20 food processing technologies, using the same rating procedure that they used previously in the baseline session.

Results

Consumer concerns about novel food technologies

Concern levels obtained during the baseline session for the different food processing/preservation technologies were analyzed both in terms of percent responses and mean values. Fig. 1 shows the percent of individuals who expressed some degree of concern ('slight' or greater) toward the various technologies, along with the total percentage of 'uncertain' responses for each technology.

As can be seen, 'genetic engineering', 'the use of bacteriocins', 'irradiation', and 'pulsed X-rays' all elicited concern among greater than 60% of the consumer test population. Among the processes that evoked the least concern were 'heat pasteurization', 'thermal energy', 'cold preservation', and 'electrical resistance heating'.

Mean ratings of concern were calculated for each technology and compared to the percentages shown in Fig. 1. Overall, the rank order of mean levels of concern for the different technologies paralleled the rank order of concern based on the percentage of individuals expressing some degree of concern. The Spearman rho correlation coefficient calculated between these rank orders was 0.99 ($p < 0.001$).

Fig. 2 shows the mean levels of concern by gender. Although the Pearson correlation coefficient calculated for the relationship between the mean concern ratings of males and females was high ($r = .91$, $p < .001$), a two-way ANOVA (gender × technology name) showed a significant main effect of both technology name ($F = 13.80$, $df = 19$, $1451, p < 0.001$) and gender ($F = 50.72, df = 1$, 1451, $p < 0.001$) with no interaction. The gender effect is clearly seen in Fig. 2, where the mean level of concern for every food technology is *greater* for females than for males. In addition, females had generally higher percentages of 'uncertain' responses for almost all technologies (data not shown).

Fig. 3 shows a similar ranking of mean levels of concern sorted on the basis of whether or not the subjects were drawn from the subgroup of consumers who had previously volunteered to taste irradiated food. Here again, the Pearson correlation coefficient between mean levels of concern for volunteers and non-volunteers was very high ($r = 0.96$, $p < 0.001$). In addition, a two-way ANOVA (volunteer status × technology name) showed a main effect of technology name ($F = 15.33$, $df = 19$, 1451, $p < 0.001$) and volunteer status ($F = 16.10$, $df = 1$, 1451, $p < 0.001$) with no interaction. The main effect of volunteer status can be seen in the data of Fig. 3 by the fact that the mean concern ratings for every technology were *lower* among subjects who had previously volunteered to taste/consume irradiated food products than for those who had not. It appears from these data that the willingness to try foods processed by one novel or potentially 'risky' technology is associated with a lower level of concern about the risks associated with a broad range of novel food processing technologies.

Association between concern levels and expected liking/disliking

With regard to the relationship between baseline concern levels and expected liking/disliking, Pearson product–moment correlation coefficients were calculated to assess the association between concern levels and expected liking/disliking ratings made prior to the presentation of the chocolate puddings in all three test conditions. Significant negative correlation coefficients were obtained between the two measures for all test conditions (Name Only: $r = -0.45$, $p < 0.01$; Name + Description: $r = -0.31$, $p < 0.01$; Name + Description + Benefit: $r = -0.40$, $p < 0.01$). Thus, the higher the level of concern for any technology, the lower the expected liking for a product processed by that technology.

Expected liking/disliking relative to baseline preference ratings

The different subject groups participating in the study had very similar baseline preferences for chocolate pudding. The mean preference rating for the subjects participating in the Name Only Condition was 7.8, while the mean preference rating for the subjects in the Name + Description and Name + Description + Benefit conditions was 7.6. Thus, differences in subjects' baseline preferences for chocolate pudding are unlikely to have influenced the data in any meaningful way.

Since expected liking/disliking ratings made prior to the presentation of the test samples in each of the information conditions were made using the same 9-pt hedonic scale used to rate 'preference' or liking/disliking for chocolate pudding in the absence of a sample or information in the baseline session, comparisons of these ratings were made in order to determine the influence of product information on projected liking/disliking ratings for an unseen and untasted product. Within-subjects ANOVAs with Tukey Multiple Range post-hoc tests were conducted on the baseline preference ratings and expected liking ratings within each information condition. Results showed significant main effects in all conditions (Name Only: $F = 26.61, df = 6, \times 246$; $p < 0.001$; Name + Description: $F = 16.66$, $df = 8, 360$; $p < .001$; Name + Description + Benefit: $F = 20.04$, $df = 4, 180$; $p < 0.001$) and all showed the preference ratings to be significantly higher ($p < 0.05$) than the expected liking/disliking ratings for every technology manipulation, including even those technologies that would not be considered novel and for which concern levels were relatively low, e.g. 'heat pasteurization'. Although the order of mean expected liking/disliking ratings varied somewhat among information conditions, the expected liking/disliking ratings for products thought to be treated by 'the addition of bacteriocins' were significantly lower ($p < 0.05$) than all other technologies in all three information conditions. In the two conditions in which they were employed, 'heat pasteurization' and 'cold preservation' elicited the highest expected liking/disliking ratings.

Expected liking/disliking as affected by information

A between subjects ANOVA conducted across information conditions and processing technologies common to those conditions showed no effect of information on expected liking/disliking ratings. However, since expected liking/disliking ratings are also dependent upon subject-specific variables, e.g. product familiarity, past experience, etc, matched t-tests were conducted on the expected liking/disliking ratings for subjects who participated in *both* the Name + Description and Name + Description + Benefit conditions. The results of these tests showed positive effects (higher expected liking) in the condition where the safety/benefit statement was presented for three of the four technologies common to both conditions, i.e. 'the addition of bacteriocins' ($t = 1.95, df = 45, p < 0.01$), 'pulsed electric fields' ($t = 1.95, df = 45, p < 0.05$) and 'high voltage pulse treatment' ($t = 1.77, df = 45, p < 0.05$).

In order to examine the effect of information on the change in expected liking/disliking ratings from baseline levels, while also controlling for differences between subjects in the various information conditions, within-subject difference scores were calculated between expected liking/disliking ratings in the baseline session (preference ratings) and expected liking/disliking ratings made prior to (visual) product exposure. These mean difference scores are shown in Table 2. As can be seen, all difference scores were negative, reflecting the fact that expected liking/disliking ratings declined from baseline levels in all information conditions. A two-way ANOVA (information condition × technology) conducted on the difference scores for the technologies common to all three conditions showed a significant main effect of technology ($F = 8.69$, $df = 3$, × 524, $p < 0.001$) and a marginal effect of information condition (F = 2.67, df = 2, 524, p = .07). Although the information effect was only marginal, examination of the data in Table 2 shows that, with the exception of 'irradiation', the declines in expected liking/disliking ratings following exposure to product information grew smaller as information level increased (Name Only Condition > Name + Description Condition > Name + Description + Benefit Condition). These data are consistent with the hypothesis that knowledge that a food product has been processed by a novel technology for which there is some degree of consumer concern will decrease expected liking for the product (i.e. all difference scores are negative). The data are also consistent with the notion that factual information about that technology, as provided in the Name + Description Condition, may reduce the uncertainty associated with the technology (Heyduk and Bahrick, 1977; Tuorila et al., 1994b) and, in turn, improve its expected liking (decline in difference scores from the Name Only to the Name + Description Condition). Lastly, the data are consistent with the hypothesis that a safety/benefit statement can positively influence attitudes toward novel technologies and further improve expected liking/disliking of the product (decline from Name + Description Condition to Name + Description + Benefit Condition).

Table 2
Mean differences between expected liking/disliking ratings made prior to viewing the sample and expected liking/disliking ratings made in the baseline session (preference ratings) for each of the three information conditions

	Change in expected liking/disliking		
	Name only	Name + description	Name + descript. + benefit
Addition of bacteriocins	−2.26(1.90)	−2.09(2.16)	−1.52(1.70)
Irradiation	−1.26(1.08)	−1.30(1.66)	−1.33(1.45)
Pulsed electric fields	−1.31(1.20)	−1.24(1.37)	−0.91(1.38)
High voltage pulses	−1.31(1.28)	−1.15(1.37)	−0.96(1.26)
Heat pasteurization	−0.93(1.11)	−0.89(1.25)	
Cold preservation	−1.00(1.31)		

Expected liking/disliking before versus after sample viewing

Table 3 shows the expected liking/disliking ratings of subjects prior to viewing the test samples (Unseen) and after viewing the test samples (Seen) by both information condition and technology. As noted previously, there was no effect of information condition on expected liking ratings made immediately following the information manipulation but before product viewing (columns labeled 'Unseen' in Table 3). However, with one exception, it can be seen that expected liking/disliking for the chocolate puddings increased after subjects were allowed to see the chocolate pudding. Of the 18 pre-post viewing comparisons in Table 3, the only exception to this finding occurred in the Name Only Condition for 'cold preservation'.

Two-way ANOVAs (Unseen/Seen × technology) conducted on the data for each condition separately showed main effects of viewing the product on expected liking/disliking ratings in every condition (Name Only: $F = 10.12$, $df = 1, 41$, $p = 0.003$; Name + Description: $F = 12.94$, $df = 1, 45$, $p = 0.001$; Name + Description + Benefit: $F = 11.84$, $df = 1, 45$, $p = 0.001$). Significant main effects of the technology were also observed in all three conditions (Name Only: $F = 11.89$, $df = 5, 205$, $p < 0.001$; Name + Description: $F = 7.01$, $df = 7, 315$, $p < 0.001$; Name + Description + Benefit: $F = 4.62$, $df = 3, 135$, $p = 0.001$), In addition, significant interactions occurred in the Name only ($F = 2.68$, $df = 5, 205$, $p < 0.001$) and Name + Description ($F = 1.79$, $df = 7, 315$, $p < 0.001$) conditions.

Change in product acceptance as a function of expected liking/disliking

In terms of liking/disliking of the taste of the chocolate puddings in the baseline condition, subjects in the Name Only Condition had somewhat higher mean ratings (7.3, 7.2, and 7.6 for Hunt's, Jell-O and Swiss Miss, respectively) than did the subjects in the other two information conditions (6.7, 6.6, 7.2). However, these differences in absolute levels of liking are accounted for in the statistical analyses of the acceptance data by examining only within-subject changes in liking/disliking between the baseline and test conditions.

Table 3
Ratings of expected liking/disliking for the chocolate puddings prior to presentation and viewing (unseen) and after presentation and viewing (seen) for all three information conditions

	Information condition					
	Name only		Name + description		Name + description + benefit	
	Unseen	Seen	Unseen	Seen	Unseen	Seen
Pulsed electric fields	6.57	6.79	6.35	6.76	6.67	6.96
Irradiation	6.57	6.79	6.28	6.37	6.26	6.74
Addition of bacteriocins	5.57	6.48	5.50	6.41	6.07	6.57
High voltage pulses	6.52	7.00	6.43	6.93	6.63	6.80
Heat pasteurization	6.90	7.21	6.70	6.96		
Cold preservation	6.83	6.64				
Non-thermal preservation			6.63	6.70		
Hydrostatic pressure			6.52	6.91		
Pulsed light	6.37	6.98				

In order to assess whether product liking/disliking assimilated (moved in the direction of) the pre-trial expected liking/disliking ratings, the change in product liking/disliking from the baseline session (blind tasting, no information) to the information session (for all three conditions combined) was plotted as a function of whether or not subjects expected a better or worse product prior to tasting (expected liking/disliking rating made after information exposure and product viewing ('Seen') relative to their baseline acceptance rating). These data are shown in Fig. 4, along with the best fitting linear regression line through the data.

As can be seen in Fig. 4, the worse that subjects expected the chocolate pudding to be, the lower the actual rating of the chocolate pudding (relative to his/her own baseline rating). The greater the expected liking, the greater was their rating of the tasted product relative to the baseline. These data show clearly that post-test ratings of product acceptance assimilate the level of expected liking/disliking, providing direct support for an assimilation model of disconfirmed expectations. The linear correlation coefficient for the best-fitting line to the data in Fig. 4 is −0.639, which accounts for over 40% of the variance in the data.

Pre-test versus post-test concern ratings

A two-way, within-subjects ANOVA (pre/post × technology name) comparing the post-test concern ratings

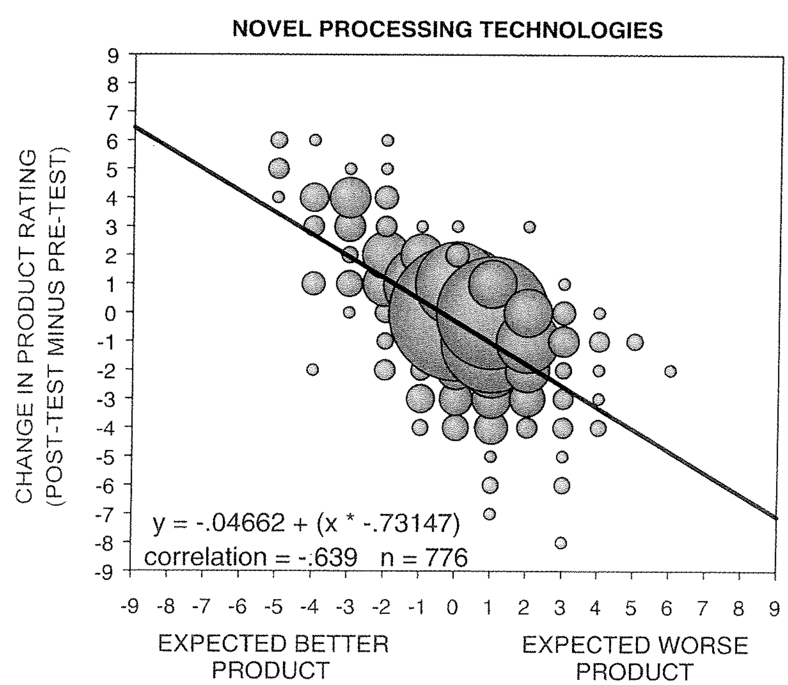

Fig. 4. Change in product liking as a function of whether subjects expected a better or worse product.

for the 20 food technologies shown in Figs. 1–3 to the pre-test ratings for subjects who participated in both the Name + Description and the Name + Description + Benefit conditions revealed a significant pre/post main effect ($F = 14.56$, $df = 1, 751$; $p < 0.001$) and a significant main effect of technology name ($F = 8.06$, $df = 19, \times 751$; $p < 0.001$) with no interaction effect. Examination of the mean concern levels showed a decline in concern between pre-test and post-test ratings for 15 of the 20 food processing technologies. These findings suggest that exposure to factual information about novel food processes and their benefits, along with product exposure (visual and taste), can serve to mitigate concerns about a broad range of processing technologies.

Since females and those subjects who had not previously volunteered to participate in tests of irradiated foods were found to have significantly higher baseline concern ratings, three-way repeated measures ANOVAs were conducted to determine whether there was an interaction between either of these variables and the pre/post effect on concern ratings. When incorporating gender as a variable, ANOVA still showed a main pre/post effect ($F = 28.69$, $df = 1, 931$, $p < 0.001$) and a main effect of technology name ($F = 8.14$, $df = 19, 731$, $p < 0.001$). However, there was also a main effect of gender ($F = 21.73$, $df = 1, 731$, $p < 0.001$) and a significant interaction of gender × pre/post ($F = 39.80$, $df = 1, 731$, $p < 0.001$). The latter effect was represented in a much larger decline in concern ratings from pre-test to post-test for females. The only other interaction that was significant was between technology name and the pre/post effect ($F = 1.81$, $df = 19, 731$, $p < 0.05$), indicating that concern levels for some technologies declined more than others.

In order to assess whether or not this second interaction was related to the fact that subjects were only exposed to a small subset of the 20 technologies during the testing phases of the study, separate ANOVAs were conducted on the 14 technologies for which no information manipulations were conducted and for which declines in concern might not be expected (or expected to be slight) versus the four technologies used in the Name + Description + Benefit condition and for which the largest declines in concern might be expected. Results of these ANOVAs showed that both subsets of technologies showed significant declines in rated concern levels from pre-test to post-test (no information technologies: $F = 7.89$, $df = 1, 512$, $p < 0.01$; maximum information technologies: $F = 8.80$, $df = 1, 157$, $p > 0.01$) and that significant effects of technology name still resided within each subset (no information technologies: $F = 6.15$, $df = 13, 512$, $p < 0.001$; maximum information technologies: $F = 12.26$, $df = 3, 157$, $p < 0.001$).

The analysis of pre/post effects incorporating the effect of whether or not subjects had previously volunteered to test irradiated foods also resulted in a main pre/post effect ($F = 16.79$, $df = 1, 731$, $p < 0.001$) and a main effect of technology name ($F = 8.32$, $df = 19, 731$, $p < 0.001$). However, there was also a main effect of volunteer status ($F = 31.95$, $df = 1, 731$, $p < 0.001$) and a significant interaction of volunteer status × pre/post ($F = 27.58$, $df = 1, 731$, $p < 0.001$). Examination of the mean declines in concern ratings from pre-test to post-test showed that concern ratings declined much more for non-volunteers than for volunteers. No other interaction effects were significant.

Discussion and conclusions

Consumer concerns for the various food processing/preservation technologies examined in this study varied greatly by technology (Figs. 1–3) and was dependent upon both gender (Fig. 2) and previous willingness to participate in tests of foods processed by novel technologies, i.e. irradiation (Fig. 3). Although many of the processing technologies that elicited the highest levels of concern were expected to do so, e.g. 'genetic engineering', 'irradiation', and 'pulsed X-rays', some, like 'the addition of bacteriocins', were unanticipated. Although bacteriocins are antimicrobial proteins produced by certain bacterial cultures, e.g. lactic acid bacteria, that inhibit the growth of competing spoilage and pathogenic bacteria, it appears that, without information to the contrary, many consumers interpret the technology to involve adding undesirable bacteria to the food. Other technologies that produced concern levels that were unexpectedly high, relative to other listed technologies, included 'modified atmospheres' and 'aseptic processing', two technologies that are commonly used in commercial food practice and for which foods processed by these technologies can be found in any supermarket. Of some interest to those researchers concerned with the marketing of irradiated foods is the fact that the term 'ionizing energy' elicited somewhat lower levels of concern than the term 'irradiation'. Previous research on consumer responses to the term 'irradiated' has shown a strong negative reaction to this word (Titlebaum et al., 1983). Although the latter study also found that misleading euphemisms for food irradiation are undesirable, the present data suggest that 'ionizing energy' may serve as a more acceptable descriptive term for this process. Also of interest to those researchers concerned with the marketing of foods processed by emerging non-thermal processes, e.g. pulsed electric fields, ultrasound, and hydrostatic pressure, is the fact that these technology names elicited much lower levels of concern than 'irradiation', 'genetic engineering' and other, more controversial technologies.

The fact that females had generally higher levels of concern than males (Fig. 2) is consistent with previous studies that have looked for gender differences in the reactions to such novel or risky technologies as food irradiation (Malone, 1990; Terry & Tabor, 1988). However, the fact that females had higher levels of concern for *every* technology name, including the most common and least hazardous technologies, e.g. 'thermal energy' and 'heat pasteurization', suggests that this difference between males and females is not specific to novel or risky technologies. The fact that females also had a much higher percentage of 'uncertain' responses for all the technologies suggests that their response pattern may simply reflect a more conservative or cautionary approach when making risk and concern assessments.

Of equal importance and magnitude to the differences in concern levels by gender are the differences observed between individuals who had previously volunteered to test irradiated foods and those who had not (Fig. 3). The subjects who had volunteered to test irradiated foods were identical in all respects (including approximate gender ratio) to those who had not. The only difference was that they had previously agreed to participate in tests of irradiated foods, had signed an informed consent to do so, and had participated in tests of irradiated foods when asked. While the data in Fig. 3 indicate that subjects who had previously volunteered to test irradiated foods had lower mean concern ratings for both 'irradiation' and 'ionizing energy', it is of some interest and importance that they also had lower mean concern ratings for every other technology that was examined. These latter data suggest that either these subjects had generally lower *a priori* concerns for novel and/or conventional processes used to treat foods and, therefore, were more likely to volunteer for testing of foods processed by a novel technology (irradiation) or the information about the risks and benefits of irradiated foods that was imparted through the informed consent that they signed and/or their subsequent participation in tests of irradiated foods (without consequence) lowered their concern levels for all food processing/preservation technologies. Since all of the subjects falling into the 'volunteer' category in Fig. 3 had already participated in tests of irradiated foods prior to participation in this study, it is impossible to discern which of these two factors could be responsible for their lower concern levels.

The negative correlations obtained between concern levels and expected liking/disliking ratings support a negative association between these two variables. Higher concern levels for a technology are associated with lower expected liking ratings, while lower levels of concern are associated with higher expected liking ratings. Although these correlations do not imply causation, they do leave open the possibility that concerns associated with the safety of a food processing/preservation technology can influence liking/disliking of tasted samples of that food through alterations in the expected liking/disliking of the food. In the present case, the lower hedonic expectations associated with technologies that are of greater concern would be expected to produce lower levels of liking for these foods through the assimilation of those expectations (Cardello et al., 1996; Helleman et al., 1995, Anderson, 1973; Bearden & Teel, 1983; Cardello & Sawyer, 1992; Lange et al., 1999; Oliver, 1977; Olshavsky & Miller, 1972; Olson & Dover, 1976; Schifferstein et al., 1999; Tuorila et al., 1994a).

More direct support for the notion that consumer concerns associated with a food processing/preservation technology can influence expected liking/disliking is found in the comparison of expected liking/disliking ratings for the chocolate puddings made prior to presentation of the products with baseline (pre-information) preference ratings for chocolate pudding (Table 2). If one considers the key elements of what constitutes an attitude-based 'preference' rating for a food item, it is, in essence, a rating of liking/disliking for a food in response to that food's name. Thus, when you ask someone 'how much do you like/dislike chocolate pudding?', you are essentially asking him or her to consider all of the chocolate puddings that they have ever eaten and to generate an integrated rating that summarizes their overall liking for this type of product. This rating may well be considered to be the best pre-trial estimate of the subject's liking/disliking for any unspecified, future chocolate pudding. In this sense, it is functionally identical to an expected liking/disliking rating for chocolate pudding. Thus, by comparing subjects' baseline preference ratings to their expected liking/disliking ratings made immediately after they were provided information that the product to be presented was processed/preserved by a particular technology (i.e. not just any chocolate pudding), we are able to more directly assess the influence of that technology name and its cognitive associations on expected liking/disliking. In the present case, a significant decline in expected liking/disliking ratings from baseline preference ratings was observed for all technologies in all information conditions. In addition, the overall pattern of these declines is consistent with the magnitudes of concern associated with the various technologies. That is, the largest decline in all information conditions was observed when the information provided to subjects was that the chocolate pudding was processed by 'the addition of bacteriocins' (Table 2), the technology name that had the highest concern level of all the technologies used in the tasting portion of the study (see Figs. 1–3). Similarly, technologies associated with the lowest concern levels, e.g. 'heat pasteurization' and 'cold preservation' showed the least decline from baseline preference levels. Technologies of intermediate concern levels, not surprisingly, resulted in intermediate declines in expected liking/disliking ratings from baseline preference levels.

It may be reasonably asked why all the technology names, even those with low concern levels, produced a decline in expected 'liking/disliking. This may be partly attributable to the particular food item chosen for study here, i.e. chocolate pudding. Puddings can be prepared from a 'scratch' recipe with only minor cooking involved. Perhaps with this type of product, any treatment, even 'heat pasteurization' or refrigeration are perceived to have a negative effect on expected liking for the product. If, on the other hand, we had chosen to use a product that, almost by definition, was highly processed, e.g. snack foods, frozen dinners, or delicatessen meat, certain technology/process names might not produce a decline in expected liking for the product, primarily because such a technology would be expected in the normal processing of the item. However, for fresh foods or those that can be produced with minimal processing, any processing beyond that implied in the product name may well be perceived as a potentially negative factor influencing expected liking. Only additional empirical testing with other food items can resolve this question.

The fact that the decline in expected/liking ratings from baseline preference ratings for the chocolate puddings was greatest in the Name Only Condition and lowest in the Name + Description + Benefit Condition (Table 2) is consistent with previous observations and hypotheses suggesting that the uncertainty associated with a novel product induces a certain degree of expected disliking toward the product, but that additional factual information will serve to reduce this uncertainty and improve expected liking/disliking (Tuorila et al., 1994b). This explanation derives from data in animals and humans showing that, in situations that involve risk or danger, low levels of uncertainty are preferred (e.g. Seligman, Maier, & Solomon, 1971; Slovic, Fischoff, & Lichtenstein, 1980). The data are also consistent with data showing that increased knowledge about both food and non-food risks can increase the acceptance of these risks by consumers (Marlier, 1992; Pohlman et al., 1994; Sjoberg & Drottz-Sjoberg, 1988; Terry & Tabor, 1990), although this relationship is not universal (Frewer et al., 1994). Lastly, the data are consistent with previous studies showing that statements about the benefits associated with a particular food or food processing/preservation technique will reduce concerns toward the food/technology and improve both its acceptance and its likelihood of consumption (Bruhn, 1995a; Frewer et al., 1997a; Schutz et al., 1989).

The results comparing expected liking/disliking ratings prior to and following viewing of the chocolate puddings in the three information conditions (Seen vs. Unseen in Table 3) shows a significant positive effect of simple visual exposure to the products on expected liking/disliking. In previous research, it has been shown that mere exposure to the taste of a food will improve subsequent liking for the food (Rozin & Schiller, 1980; Zellner, 1991). Similarly, presentation and tasting of a food sample has been shown to improve the intended likelihood of purchasing irradiated foods (Hashim et al., 1996; Pohlman et al., 1994). Visual exposure, by itself, has also been shown to improve the expected liking/disliking of novel products (Tuorila et al., 1994b). In the latter study, it was suggested that viewing the product reduces uncertainty about it, thereby, having a positive influence on attitudes toward it. Obviously, this positive influence is dependent upon the fact that the viewed product has visual characteristics that are generally consistent with the product category and that do not disconfirm subjects' expectations of what constitutes 'normal' appearance for an acceptable product in this food class. In the present study, all of the samples consisted of national commercial brands of chocolate pudding. As such, their visual characteristics would have to be considered normal and representative of acceptable chocolate puddings sold in the United States.

The positive influence of product exposure, factual product information, and safety and benefit statements, as reflected in the increase in expected liking ratings after viewing the products and the smaller declines in expected liking with increasing information, also translates into long-term changes in attitudes toward a variety of food processing/preservation techniques. This conclusion is supported by the significant post-treatment decline in concern ratings for many of the 20 technologies examined in the baseline session. The post-test concern ratings for these technologies were obtained from subjects who had participated in both the Name + Description and the Name + Description + Benefit conditions. These subjects had been exposed to 12 chocolate puddings that were represented as having been processed by a variety of novel food processing/preservation techniques. They also were provided factual information about these technologies and had been presented safety and benefit statements for a subset of them. Since lower post-test concern ratings were observed among both the subset of the technologies for which information had been presented, as well as for the technologies for which no information was presented, the data are consistent with the notion that exposure to novel products and/or relevant information about these products, their safety, and their benefits will not only reduce concern levels for the exposed technologies, but will also reduce concern levels for foods processed by other technologies.

The fact that the concern ratings of females and of individuals who had not previously volunteered to test irradiated foods declined much more from pre-test to post-test levels is of some interest to researchers working to develop marketing strategies for foods processed by novel and/or emerging technologies. Both of these subgroups of the test population had the highest levels of concern in the pre-test (baseline) session. Thus, on an absolute basis, their concern levels had the greatest potential to be positively influenced by the information treatments. However, the robust nature of the differences in the baseline levels of concern among these groups (vice males and vice volunteers) suggests that informational strategies should be focused to appeal to both women and those who, based on some behavioral criteria, are considered less prone to trying novel or high technology products/foods. Such groups may include 'green' or 'alternative' shoppers, as well as individuals who score high on measures of neophobia.

In keeping with the majority of recent research on the effect of consumer expectations on product acceptance, the within-subject analysis of the influence of the confirmation/disconfirmation of expectations (expected liking ratings relative to baseline) on the change in product acceptance (Fig. 4) supports an assimilation model of these effects. When subjects expected a better product (regardless of the information used to form the expectation), product liking improved from the initial baseline session. When subjects expected a worse product, liking declined. These data underscore the critical importance of attempting to understand the complex set of factors that influence consumers' expectations toward a product. In the case of most commercial food products, these expectations can be influenced by a wide range of variables, including past experiences with the product, brand preferences, nutrition information, advertising, labeling, and the like. However, for many products that are under development and that are either novel in their source, sensory characteristics, ingredients, or processing and preservation, the primary driver of expected liking prior to market introduction will be the information that is provided to the public about the novel nature of these variables. To the extent that consumers have negative attitudes or concerns about either the safety of these processes, the products produced by them, or the products' likely sensory characteristics, expected liking/disliking of the food and, in turn, actual liking for the tasted product will suffer.

The present research has provided evidence that consumer concerns toward the technologies used to process and preserve foods may be an important variable influencing the expected liking/disliking for the product. It has also provided evidence that factual information about these technologies, clear statements about the safety and benefit of these technologies, and exposure to visual product characteristics can all improve expected liking and increase the chances of consumer acceptance upon initial trial. Future research on novel food processing and preservation technologies, including genetic engineering, irradiation, and other emerging non-thermal technologies should move forward from simple assessments of consumer concerns about the technologies and begin to focus more directly on questions and issues related to the consumer's expected liking/disliking for the products of these technologies. In this way, we can begin to develop both a better understanding of the variables that directly influence the acceptance of these products and more effective marketing and informational strategies to improve their likely success in tomorrow's marketplace.

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