Marketing of Biotech Functional Foods in the US
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AAEA Annual Meeting August 1-4, 2004
Denver, Colorado

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Abstract

To date, most research in Europe and the United States has focused on eliciting consumer WTP for biotech foods without directly addressing strategies for marketing them. We use means-end theory to link consumers' knowledge about functional attributes, to their knowledge about consequences and core values, in order to gain insights into valued attributes for developing potential marketing strategies.

Subject Area:

Public Acceptance, Product Positioning, Marketing, Functional Foods, Agribusiness

Introduction

A functional food is any food or food ingredient that contains health benefits beyond the traditional nutrients that are contained in the food (or food ingredient) itself. The immediate potential for marketing biotech functional foods to US consumers lies in making a direct link between health and nutrition. Eighty nine percent of US consumers indicate that nutrition is important to them when choosing food items or brands (Hoban, 1998). Seventy percent of US consumers indicate that they would pay more for healthier versions of foods. Therefore, it is likely that a significant share of US consumers will be willing to accept (and pay premiums for) biotech functional foods. One can postulate that biotech functional foods that offer unique and identifiable consumer benefits will be more easily marketed and command higher premiums than products lacking such benefits.

To date most research in Europe and the US has focused on consumer willingness to pay for biotech foods (first generation or otherwise) without directly addressing strategies for marketing them to consumers. Such research neglects the fundamentals of food marketing, product development, and product positioning. And one important finding from marketing is that understanding the personal values that consumers hold about new products is critical in such efforts.

The personal values that consumers attach to products can be broken down into two types: instrumental and terminal. Instrumental values are those values associated with preferred modes of conduct or ways of behaving, such as, "being independent" or "having a good time." On the other hand, terminal values are preferred states of being or broad psychological states, such as, being happy, successful, loved, or at peace. Instrumental and terminal values represent the broadest and most personal consequences that people try to achieve in their lives. And these values have a large influence on the cognitive processes of consumers and on their choice behaviours. For instance, the core value of protecting the environment has created marketing opportunities across a broad range of products (Peter & Olson, 1996).

Understanding personal values of consumers is important in new product development and advertising as well. Without first understanding the personal values that consumers hold the marketing costs and possible consumer resistance to introducing new products can be prohibitive for firms and industries. While US consumers have perceived potential risks associated with biotech foods they have generally been more accepting of first generation biotech foods than European consumers. Likewise, US consumers are already making a direct link between health and nutrition. Therefore, it is likely that a significant share of US consumers will be willing to accept (and pay premiums for) biotech functional foods. One can postulate that biotech functional foods that offer unique and identifiable consumer benefits will be more easily marketed and command higher premiums than products lacking such benefits.

The main objective of this study is to identify yogurts which meet specific health needs and market them to consumers on the basis of their desirable (benefit) attributes using the

means end chain (MEC) approach. The results presented in this paper are based on a convenience sample that is illustrative of our current research design and ongoing data collection.

Defining the Market for Functional Foods

Although there is no current legal definition of functional foods in the United States, a generally accepted definition is *any modified food or food ingredient that provides physiological benefits beyond basic nutrition, such as medical and health benefits*. Functional foods have a positive impact on a person's health, physical performance or state of mind (Sheehy & Morrissey, 1998, p.46, ADA 1995) and can be whole, fortified, enriched, or enhanced (Meister, 2002, p.8). The category can also include foods from which harmful components (e.g., trans-fatty acids) have been removed. Such foods are easily incorporated into an everyday diet because they are similar in appearance (and taste) to conventional foods.

Markets for functional foods, however defined, are broad and growing very rapidly in the US, Europe, and Japan. In the US, the functional food market was valued at $16 billion in 2001 and is expected to grow 10-15% annually (Greenberg, 2003). While there have been considerable market successes in the US – "Take Control" (a spread which lowers LDL cholesterol), Yakult (a probiotic drink which improves digestion), cranberry juice (which prevents urinary tract infections) and calcium fortified juices (which promote healthy bone development); not all products have done so well. For example, Benecol, a margarine which lowers LDL cholesterol (and which proved successful in Europe), has had limited success in the US. Benecol is priced considerably higher in the US than its competitor brand (Take Control).

It is hoped that functional foods will ultimately reduce the incidence of disease and increase life expectancy (Sheehy & Morrissey, 1998). Hence, potential benefits may go beyond individual consumers to include the potential to reduce health costs and public health expenditures (de Heer, 2002). The high costs associated with the current medical system within the US, and an increasing interest in self-medication, are also likely to be prominent factors in the long term growth of such foods.

Means-End Chain (MEC)

Means end chain (MEC) theory is made up of two views: motivational and cognitive structural views. The motivational structural view looks at consumers' buying behaviour, while the cognitive view looks at the consumers' internal knowledge of a particular product or products (Olson & Reynolds, 2001). The MEC theory is used as a theoretical framework for understanding how a consumer's product knowledge is linked to different core values. It visually displays the knowledge structure of consumers linking consumers' knowledge about attributes (A) to their knowledge about consequences (C) and values (V). The means-end perspective suggests that consumers think about product attributes subjectively in terms of personal consequences — "What is this attribute good for?" "What does it do for me?"

We use MEC analysis to address the following research questions:

- What is the degree to which US consumers' trade off functional benefits versus perceived risks of biotech foods?
- What are the specific attributes (e.g., health) that different segments of US consumer's value?

In order to elicit the means-end chains we use hard laddering techniques. These techniques allow for a variety of ways of eliciting consumer values. We employ multidimensional scaling techniques to transform the participants' product preferences into similarity indexes so that meaningful market segments can be identified on the basis of bundles of product attributes.

Design of Study

The design of study provides details on the research sample size, product design, and laddering technique. A discussion of each design component follows next.

Research Sample Size

The results discussed here are generated from a convenience sample of 10 consumers interviewed in the pre-testing phase of our study. The ongoing study sample is 60 households randomly drawn from the population of a college town in the Midwest. The sample is composed of females, aged 20 to 50, who have children, and regularly purchase milk based yogurts. Eight products with various benefit attributes and technologies (i.e., biotech microorganism, plant, animal) are ranked by the consumers prior to the hard laddering exercise. Socio-demographic information concerning age, education, occupation, number of children, age of children, newspaper read, and other attitudinal questions are also collected in an exit survey.

Product Descriptions

The consumers' perceptions and acceptability of yogurts are analysed on the following dimensions: soy vs. yogurt; biotech ingredients, levels of a biotech ingredient present; and the functional benefit the yogurt offers to the consumer. Yogurts were designed for the study to minimize hypothetical bias and because they allowed for three levels of modifications: plant, microorganism, and animal (see table 1).

Table 1: Product Characteristics

A	B
• **Soy** yogurt produced by organic methods • Traditional flavour and texture • **Soy** yogurt is naturally lactose free • Production requires less pesticides • Higher priced yogurt	• **Milk** yogurt produced by organic methods • Traditional flavour and texture • Production requires less pesticides • Higher priced yogurt
C	**D**
• **Soy** yogurt produced from non-biotech soybeans • Traditional flavour and texture • **Soy** yogurt is naturally lactose free	• **Milk** yogurt produced from non-rBST treated cows • Traditional flavour and texture
E	**F**
• **Milk** production increased by using rBST on cows • Traditional flavour and texture • Increased milk yield results in a lower priced **milk** yogurt	• **Soy** yogurt that contains a biotech culture • This results in a **soy** yogurt with no bean taste • The culture increases absorption of calcium and other nutrients • The culture reduces blood cholesterol • **Soy** yogurt is naturally lactose free
G	**H**
• **Milk** yogurt that contains a biotech culture • The biotech culture produces a yogurt with a more creamy texture and rich flavour • The biotech culture produces a **milk** yogurt higher in protein	• Biotech **soybeans** are used in yogurt • This results in a **soy** yogurt with no bean taste • The beans eliminate soy allergies • Production requires less pesticides • **Soy** yogurt is naturally lactose free

Analysis of Ranking Data: Based on Weighted Sums

Table 2 demonstrates consumer willingness to buy yogurts based on their various attributes. The consumers are asked to rank the yogurts based on: "will buy", "might buy", and "will not buy". Responses are coded as follows: "will buy" = 1, "might buy" = 2, and "will not buy"=3. Based on the table below, most consumer "will buy" products B and D, "might buy" products C, E, and G while they "will not buy" products A, F, and H. However, when one observes the aggregate ranking clearly no one product is preferred over any other suggesting that US consumers are willing to trade off among the functional and biotech attributes.

In terms of <u>a full ranking</u> of the yogurts based on their various attributes, product D was the most preferred product while product H was the least preferred product. Note that product D is a milk yogurt which most consumers preferred and also it is produced without non-rBST.

**Table 2: Ranking of Products: Partial Ordering Based on
Willingness to Purchase**

Products	Products: Consumer Ranking									
	1	2	3	4	5	6	7	8	9	10
A	3	3	2	2	3	1	2	2	1	3
B	1	1	1	1	2	1	2	1	1	2
C	3	2	2	2	2	2	2	2	1	3
D	1	1	1	1	1	1	1	1	1	1
E	1	2	1	3	3	3	1	2	3	1
F	2	3	3	2	2	2	1	2	2	3
G	1	3	1	2	1	2	2	2	3	2
H	2	3	3	1	3	3	2	2	2	3
Sum	14	18	14	14	17	15	13	14	14	18
Average	1.75	2.25	1.75	1.75	2.13	1.88	1.63	1.75	1.75	2.25
Rank	2	2	2	2	2	2	2	2	2	2

Table 3: Ranking of Products: Full Ranking

Consumer	Products: Full Ranking							
	A	B	C	D	E	F	G	H
1	8	4	7	3	2	5	1	6
2	5	2	4	1	3	8	7	6
3	8	7	6	2	1	5	3	4
4	7	3	6	1	8	4	5	2
5	6	4	5	1	8	3	2	7
6	3	2	4	1	8	6	5	7
7	7	6	8	3	4	2	1	5
8	3	1	4	2	6	7	5	8
9	1	2	4	3	8	5	7	6
10	5	4	6	2	1	7	3	8
Sum	53	35	54	19	49	52	39	59
Average	5.3	3.5	5.4	1.9	4.9	5.2	3.9	5.9
Rank	6	2	7	1	4	5	3	8

Analysis of Ranking Data Using Multidimensional Scaling (MDS)

The above orderings were obtained by using simple additive sums across consumers. An alternative way to segment the products which captures the degree of distance of consumers in their ranking is to use multidimensional scaling. "Multidimensional

Scaling (MDS) describes a family of techniques for the analysis of proximity data on a set of stimuli to reveal the hidden structure underlying the data. The similarity data can come from similarity judgments, identification confusion matrices, group data, same-different errors or any other measure or pairwise similarity" (Steyvers, 2001, p. 1). Hence, in this study we are using multidimensional scaling to examine the degree of similarity between different products based on their attributes.

The Euclidean distance model illustrates the consumers' willingness to buy different yogurts and their acceptability based on the various attributes in terms of clusters. The spatial exploration of different yogurts shows that consumers are clustered in three major clusters. In figure 1, the first cluster is composed of yogurts B and D. The second cluster is made up of yogurts E and G and yogurts A, C, F, and H make up the last cluster. These clusters represent the non-biotech, biotech milk based, and soy based yogurts, respectively. Most consumers opted to buy yogurts D and B, all ten consumers versus seven out of ten consumers. The natural, milk based attribute were a very strong factor for most consumers. Clusters 2 and 3 illustrate the milk versus soy that most consumers based their choices on. In cluster 2, four consumers "will buy" yogurt E versus three of yogurt G. This cluster is made up of biotech based milk yogurts that are not as preferred as cluster 1. The main concerns (consequences) for these consumers were based on the unknown risks or long term effects of the technology. The soy based yogurts make up cluster 3. Consumers did not seem to trade off the health attributes in the soy based yogurts over the other yogurts. The beany taste was an attribute that most consumers felt was unnatural for a yogurt[2]. The idea of having a yogurt made from soy was not something most consumers opted for. Most consumers would not consider buying many of the yogurts in cluster 3. Only one of the consumers would buy yogurts C, F, H, and two would buy yogurt A. However, when all consumers were averaged out, there were most consumers would buy or consider buying one or the other types of yogurts. Most consumers "will buy" B and D and "might buy" the rest of the yogurts. Hence, within the "might buy" none of the alternatives dominated. This means that the consumers may actually be trading off the health benefits over the biotech ingredients allowing for a potentially successful marketing strategy.

Full Ranking

Clusters 2 made up of G and F and 3 made up of A and C illustrate the products with similar attributes and how the consumers ranked them. The Euclidean distance model illustrates the milk versus soy yogurts in terms of clustering. Cluster 1 made up of yogurts B and D was the most highly acceptable product based on the fact that it was milk based, non-rbST, and organic. Most consumers felt that these products were more natural, close to what they could identify with, and safer for the environment.

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[2] This expression "beany taste" has been modified in the final study.
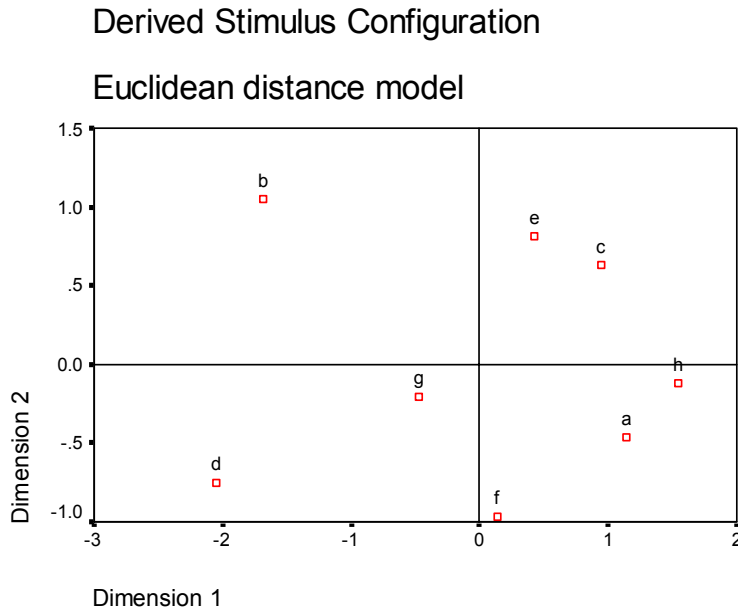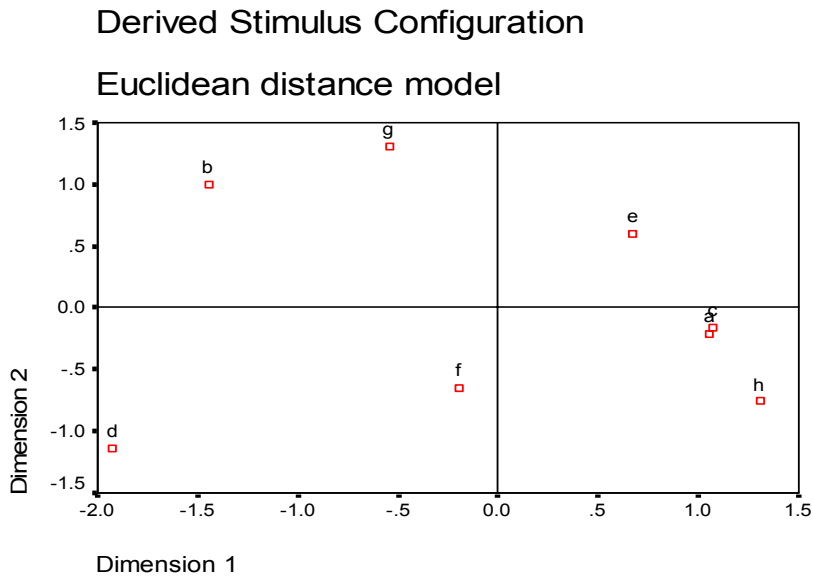
Figure 1: Consumer Willingness to Buy

Derived Stimulus Configuration

Euclidean distance model

Figure 2: Euclidean Distance Model – Product Acceptability

Derived Stimulus Configuration

Euclidean distance model

Hard Laddering

Hard laddering is used in order to get respondents to react and respond to MEC analysis using in-depth interviews and consequently uncovering the value chains (Reynolds & Gutman, 2001). Information is elicited from the consumers' memory using a suitable research strategy developed to help the consumers articulate how they feel about a certain

product when asked. The questions are asked in the form "why is that important to you?" and are reedited so that the respondent is forced "up the ladder of abstraction" which sets precedence for the next question to be asked by the interviewer (Olson, 1989). In responding to the questions, the consumer provides the interviewer with information of how she is processing the product information from a motivational point of view. In so doing, the interview process illustrates the different attributes, consequences and values that are linked when considering a specific product and a particular situation (Grunert & Grunert, 1995). The goal is to determine the set of linkages between the key perceptual elements across the range of A-C-V which aid in differentiating amongst the products that are being used in the study (Reynolds and Gutman, 2001). However, the respondent's value chain from A-C-V should be complete and reveal the consumer's underlying motivation. Laddering therefore allows the investigator to create cognitive maps (also known as Hierarchical Value Maps (HVMs)) that are used to delve into the consumers' cognitive structure (Reynolds and Gutman, 2001). Laddering is appropriate because "consumer acceptance of biotech foods is a multi-dimensional construct encompassing cognitive, affective, symbolic and normative aspects" (Henson & Harper, 2001 p.32).

The attributes, consequences and values are related to each other in terms of how the various attributes in table 3 were used to generate consequences and values using the laddering approach. Table 4 represents the consequences for the number of consumers, while table 5 illustrates the various instrumental and terminal values generated from the consequences. The strongest attribute was soy. Taste seemed to be a strong factor for the ten consumers used in the pretest which is represented by the "good food quality" consequence. Eight out of 10 consumers felt taste was a dominate factor in whether they chose a milk based yogurt over soy. Most consumers did not like the potential for a gritty or beany taste while few were ready to trade off milk based yogurts for the functional attribute in terms of health in the soy yogurt.

Health was the strongest consequences where 9 out of 10 consumer felt that health was a motivating factor for their choices in terms of what yogurts to buy. The natural (non-biotech or organic) attribute was also important. As seen in table 5, the *family and friend security* value dominated what consumers felt was important to have from the eight yogurts. Consumers also valued a *beautiful world*, *equality*, and *ethics*. There were also those consumers that were concerned about the *dreaded* effects of biotechnology, i.e., their long term health effects. Table 5 shows that the *right to know* is an important value for 5 out 10 consumers that participated in the pre-test.

From these initial findings it seems that US consumers like products that keep them healthy while at the same time taste good. They want to be informed about the products they buy while they want them to be safe for themselves, their families, and animals. Consumers want a healthy environment that supports small hold farmers.

Table 4: Coded Consequences across all Consumers

Consequence (Number)	Responses Coded as Respective Attribute
A world of beauty (6)	organic milk is better for the environment; organic milk does good things for the environment; it's been used in other food processes so it's okay; healthier and earth friendly; less run off; less fertilizers; better for the environment
Dread Effect (3)	Soybean is actually poisonous for some animals; the plant is drowned with herbicides
Ethics (2)	Other people's value for good health; I don't like soy because I feel like I being lied to and it makes me annoyed; I like to support small hold farmers
Food Quality (8)	Good taste; taste better and enjoyable to eat; gritty taste and texture is unpalatable; it's smooth; traditionally soy tastes bad; want yogurt to taste like yogurt; other source of dairy in lifestyle; convenient; higher price better product; I'd rather pay for quality; don't like soy yogurt because it taste too much of soy;
Happiness(2)	Makes me happy; makes me feel good
Health (9)	Calcium will be important for you - more important for women than men; cholesterol can be dangerous; not good for your circulation system; it's better for me; organic milk is healthy all around; more healthier; not healthy to use pesticides; other would buy it if they have a cholesterol problem; it's good that it helps absorption of calcium – you associate it with something good – bone strength; should lower pesticide residues; worry about the health effects; as a vegetarian I don't get enough protein; it's very important in bone density; it's important to absorb nutrients I don't want to waste; thinking of balanced diet; we need a fair amount of protein in our diet; others may buy it for health reasons
Natural / unnatural(8)	don't like to see that it's lactose free because I like complete products; left to nature; it's more natural; increasing production means losing nutrients; organic is the most natural; I like soy sauce and not soy yogurt; I want beans when they are beans; don't like the idea of cows treated with rbST
Price (2)	A costly yogurt; the higher price is a problem
Unknown risk (4)	Scared about the ingredients; don't know much about it; not sure what's in it; our lives are adopted to this kind of product rather than the unknown

Table 5. Terminal Values and Respective Responses across all consumers

Value (Number)	Respective Responses
An exciting life (2)	Makes me excited; creamy texture and rich flavour is enticing
A world of beauty / lack of beauty (5)	I'm supporting biodiversity; I like wildlife; if it's not good for wildlife to eat it's not good for me to eat; cows look scary; for the sake of mother nature it would be a good thing to reduce the toxins we pump into the environment; preserve's natural state
Dreaded (5)	Don't know of long term consequences; side effects; pesticide are going to give me cancer; soybean is not a healthy protein; worry about the health effects; may result in degenerative conditions
Ethics & Equality (5)	Other people's value for good health; people care for animal's welfare; other people may think vegetable proteins are better than animal proteins; don't like idea of animals raised in unnatural way; I don't like soy because I feel like I'm being lied to; I'm helping the little guy; I like to support small hold farmers; I like the perception of organic helping the litter guy; soy are overrated on their values; when I think of rbST I think of ugly cow; not a big fan of animal experimentation
Family and friends security (9)	You become old one day and calcium will be important to you; I worry about people, my friends that have food allergies; there are products out there for everybody; don't want my children eating pesticides; I buy this product because I'm thinking of my daddy; I wouldn't want to get my guest sick; I would buy this product when if have friends visiting me that are lactose intolerant; don't particularly care for soy unless my father is visiting; it would be for their health; don't have any allergies but would be useful for people who have allergies; others may find it useful – especially if they are on diet or are vegetarians
Happiness (2)	It makes me feel good; feels good buying a nutritional product; feels good to have a product that caters to my needs
Health (3)	I don't want to get osteoporosis; it would be for their health; healthy; it may prolong my life; good for one's health in terms of providing an added source of protein; they can live a healthier or safer lives; means one can live a healthier life
Honest/dishonesty (3)	Government is lying which disappoints me; they are sneaky, it's probably not labelled; makes me feel like I can trust the product more
Inner Harmony (1)	Organic milk yogurt makes me feel more comfortable
Lack of inner harmony (1)	Inappropriate use of biotechnology makes me feel annoyed
Logical (1)	Their concepts are sound
Natural/unnatural (7)	I like the traditional flavour and texture because it's what I'm use to; it's an incomplete product as far as nutrition; it's artificial; breeding biotech crops with herbicides resistant; it's more natural; it's unnatural; like more natural approach to production ; doesn't seem natural
Obedience (1)	My parents told me to drink milk
Pleasure (4)	Taste is important to me, I eat to live but not live to eat; enjoyable to eat; you get relaxed; the yogurt feels good - yummy
Quality of life (2)	High cholesterol is not good for you; healthy life style
Responsible (2)	Other will be concerned about the cows; good for women
Sense of accomplishment (1)	I feel I got a good deal
Right to know (5)	There are no labels of rbST products in the store; I feel pissed off because I don't have a choice; need more information; need long term testing of biotech; don't know how they label rbST; don't know much about biotech culture
Social recognition(1)	I want to tell my friends that I got a good deal
Unknown risk (4)	Don't know about growth hormone; if I knew more I'd probably be scared; there's much unknown; I'm not sure about the long term effects; not sure I trust the technology

Concluding Remarks

Our initial findings suggest that consumers value a natural world and natural products, health, their family and friends' security, their right to know, ethics, and equality. Dreaded effects also seems to have an impact on consumer decision making based on the perceptions that consumers have about biotechnology and the use of pesticides in general. Taste was a very important attribute and motivating factor in purchase decisions

suggesting that US consumers are less willing to purchase soy-based yogurts. Therefore, any successful marketing strategy would have to be based on these products tasting the same as their conventional (milk) counterparts. Our initial results also suggest that even though health did not dominate in terms of consequences and values many of the consumers mentioned health both as a concern (dreaded health effects) and as a potential benefit. This study suggests that US consumers are generally willing to trade off perceived potential health risks (of biotech) for potential health benefits. This finding is consistent with the broader risk communication literature and paves the way for future marketing strategies.

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