Consumer Insight and sensory evaluation

- An integration of sensory research and marketing food products in new markets -

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Abstract

Innovation is the hottest concept leading to a success of companies in ruthless market competition. Especially, product innovation in food industry is inevitable for companies not only to make a big hit but also to stabilize the sales, to increase annual revenue, and to reduce losses through product development. It is mainly supported by two research approaches, market research and product research. The market research enables firms to respond to changes in industry environment, and build market-oriented business. The product research is often considered as not only a product-focused but also a distinct science. These research tools can produce innovative outcome when they are efficiently jointed.

In this working paper, I explain how the interdisciplinary approach is important to launch an innovative food in new markets. The first chapter introduces market research and consumer's choice, giving an example of consumer insight in Japanese food market. The second chapter focuses on sensory research with practical studies on sensory evaluation on nut bars among young Japanese consumers. Overall, we strongly emphasize consumer-oriented perspective in both researches in order to succeed in entering new markets and developping long-run items.

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Introduction

Innovation is the most essential aspect to define a success of companies in ruthless market competition. Among all, product innovation in food industry is inevitable for companies not only to make a big hit but also to stabilize the sales, to increase annual revenue, and to reduce losses through product development.

A market-based innovation is defined as a product that results from making a win-win relationship between price and value, satisfying both marketers and buyers at the same time. Not only product itself has to have good quality but also marketer keeps following the market trends and consumer needs. The market studies have effectively been done by market analysists, economists, and firm consultants, and the data are sold at a high price. However, most of such data are limited only to a demographic analysis ~~and~~ extending previous trend lines. There are limited numbers of data focusing on consumer-centered analysis such as behavioral and psychological motivation in purchase. The market-based approach may make high revenue and ride on popularity, however; the possibility to touch the consumer's heart is not always secure.

A product-focused innovation can be fundamental and instrumental for firms to justify their business. Especially, for a new product development, creation of a better product by employing all the techniques they have become core values. However, there may be a risk and uncertainty of profit before launching since consumer preference and acceptance change often by some extrinsic factors.

A consumer-centered innovation is still a vague concept among analysists and scientists. In fact, it can be a part of market research and product research mainly focusing on what users want and how users react. For instance, consumer insight with which the firm can understand the purchase motivation of consumers and consumer sensory evaluation that chooses consumers as subjects of sensory tests are consumer-centered approach in food product development.

In this article, the consumer-centered market and product research will be discussed and introduced as the integrated approach to increase the potential and efficiency of research and development. Then, a discussion will be given as to how ‘consumer science’ is important in the interdisciplinary strategy.

Objective

● Consider innovation of food product based on consumer-oriented perspective

● Integrate market research and consumer insight to increase the potential and efficiency of R&D

● Understand consumer science in wider sense

Market research and consumer’s choice

(1) Demographic research

In the current condition of the economy, having a characterized target market is more critical than ever. In fact, nobody can target everybody. Small and medium-sized companies may be able to overcome large companies by focusing on a niche market.

Numerous firms say "everyone is keen on our business". Some say they target salesmen, housewives, or house-owners. However, these targets are extremely broad.

Focusing on a particular market does not imply the ignorance of the people who don't match special criteria. Instead, target marketing permits one to concentrate on the promoting money (or investment) and brand images to a particular market that has preference to particular purchases among other markets. This is an a great deal more reasonable, efficient, and powerful approach to achieve potential customers and create business.

For instance, a food manufacturing company could aim a market consisting of housewives between the ages of 25 and 35 with incomes of above $150,000 in Boston. To characterize the market more in detail, the company can focus on only those who are interested in organic and low-calorie foods. This market could be divided into two niches: wives of newlyweds caring about their shape and young mothers worrying about their kids' food.

With a well-defined target market, it is much simpler to know where and how to advertise the new business.

When choosing specific demographics as the target, it is important to clarify not only who has a requirement for the new product or service but also who is willing to buy it. The following components should be taken into consideration:

- Age
- Location
- Gender
- Income level
- Education level
- Marital or family status
- Occupation
- Ethnic background

Who will purchase and use the new products or services? Is it single moms, senior citizens, middle-class Asians, or low-class immigrants? To narrow down the target population may not be the top concern of producing company but is essentially important to figure out the future. The chances are especially good high to even a small business when it is fairly geographically specific [1].

Next question is what information do we have to collect? Here, some examples of demographic research on Japanese food market are shown.

Ageing society

In the global society, a growing number of seniors and a low fertility have been becoming a considerable issue especially in developed countries. Japan is a representative ageing country where people aged over 65 are reaching almost 30% of the total population. As of 2013, 2.2 million households, which are 45% of total number of households in Japan had at least one member of 65 years old or older [2]. Besides, due to a reduction in the family sizes, households consisting of 1-2 elderly persons are common (31% lived only with their spouse, and 26% lived alone).

The changes of age distribution and family structure have given an influence on the demand for the types of food. Over the last 10 years, the demand for fresh foods among elderly households was decreased by 6.8% while that for processed food was increased by 9.5% [3]. As the elderly has less physical activity, they face a decrease in function such as masticatory or digestive functions resulting in a poor appetite. Therefore, the amount of a serving becomes so small that sometimes cooking and preparations generate more wastes and costs. From the objective of reducing extra efforts, buying ready-made meals offers better variety and cost-efficiency [4]. In a different aspect, it is said that grocery shopping, and cooking with standing long at kitchen are tough burden for physically weak elderly consumers [5].

Single-person households

For many reasons including late marriage, desire for successful career, and high costs to raise kids, the number of single-person households accounted for 33% of total households according to the 2014 national census[2]. This is a significant increase compared to 1990~~,~~ when the share of single-person households was only 20%[2].

These single-person households choosing grocery shopping rather than dine-out or ready-made meals are significantly less found in age under 35 compared to singles aged over 35 [6]. The people of under age 35 eat–processed food and cooked meal twice more than the group aged 35 or more[6]. Many 20-30s singles care the price most in meal *selection. It makes a lot of sense that they choose food already cooked or mostly processed since such type of food is more cost-efficient compared to preparing a single meal from the fresh ingredients.*

Women in workforce

According to the Ministry of Internal Affairs and Communications, proportion of dual-income households over the total households was increased from 51% in 2002 to 57% in 2012[7]*. It is relevant to the consistent increase of female population at workforce. The actual hours those women can afford on household chores are 70% or less than the hours that full-time housewives spend*[8]*. Sadly, career women often give up cooking and preparing meals among household chores. As a consequence, the industries of ready-to-eat foods or microwavable foods have been expanded up to 38% of household food expenditure in 2010, which is much higher than 31% observed in 1995*[9]*.*

Based on the socio-demographic data in Japan, the single-household seniors appear to become potentially a strong market in the near future. This population will require advanced technology to transform texture of food and enhance nutrition. Young working mothers who feed one or two children with high quality and natural-like food are another consumer sector. Based on demographic trends, companies will plan the product development for the upcoming niche market.

(2) Consumer insight

Even though many companies these days emphasize how consumer insights are indispensable in market research, there are separated opinions about how to define insights and how to apply them to actual business. Typically, research needs to focus on the numbers, marketing and sales need more customers and strategic plans require forward-move rather than sharing and communication.

These types of approaches used to be accepted before but not now. When there were limited networks~~,~~ and life patterns were simple, it was not difficult to generalize and group the consumers into a few categories. According to the results obtained by different groups, it was possible to decide how to promote new products and attract the customers to newly developed products. However, things have been changed and now there are numerous networks, and customers can get diverse methods to express their opinions and exhibit individual’s life styles. Companies, used to approach customers by means of newspapers or radio commercial before, but now they have begun to consider the used of online marketing and SNS as the new tools to communicate with customers.

In addition to the conventional demographic analysis, consumer insights provides consumer background and behaviors which are more than just numbers but more information that can suffice deeper connection between customers and products. Compared to the traditional marketing research that offers a lot of information, consumer insights appear to be much informative regarding consumer’s thoughts, purchase motivation and the possible behavior in the future.

The next question is how to get the consumer insights? They are collected from general information combined with anthropologic or ethnographic understandings. Analysis requires broad understanding that includes cultural, historical, ethnical, and educational bases of target market. Overall combined research helps provide a deeper cultural understanding as to why an individual or a group chooses to take a specific action [10].

Consumer insights promote the businesses to establish the relationship with customers. Not just superficial but also deeper mind should be open to know each other. This step demands time and passion for researching customers.

Here, I would like to share Japanese consumer insight data before finalizing how to foresee the business.

A. *Special clients*

a) Kidult products

A new coinage, 'kidult', refers to an adult who is interested in lifestyle that is intended for kids. This concept became huge as a rebellious trend to the society's expectation that people behave as their ages.

In the similar sense, a type of food products~~,~~ called 'snacks for adults', overly hit the market in Japan. Snacks are basically "kid-friendly", mini-sized and meant to be sugary and fatty or salty and greasy to attract kids grazing. Lately in Japan, the comforting bites have found new consumers. Many confectionary manufacturers have launched a new product line targeting female consumers at age 40-60s. This range of age mostly have their children grown up enough to quit habitual snacking, meaning no change to taste snacks even though still indulge in sweets sometimes. For them, the new type of snacks have emerged that are less sweet but richer in functional compounds. Also, through designing a luxurious package and categorizing as "for adults", product reduces guiltiness of eating food that was primarily supposed to be for kids.

The concept could succeed in making 'adult' people feel privileged. From a different aspect, it appears that the 'for adult' products have limited the consumer class. However, "for adult" snacks have interestingly become loved by not only the mid ages but also young and old populations. Young people want to treat themselves as grown-ups, while elderly people want to be treated young. As a result, these populations like the term 'for adults' and purchase more of such products.

So far, the 'for adults' products have grown in market of sweets, especially chocolates. Its growth and expansion to different product areas seem fast and broad. For instance, by lowering sweetness but raising pungent property, soda drinks gained a chance to enter 'for adult' market. We can imagine how extensively the adults will happily invest on products for 'adult' themselves.

b) Premium products

Once a new product becomes a luxury brand, Japanese consumers become the world's *biggest spenders. Over the past two decades, shopping attitude of Japanese for the brand has changed significantly. People now seek for products that are outstanding in the quality offering a real value, not merely the flash of a trend. In food products, people tend to invest on "premium" products that are nicer in terms of freshness and nutrition. As the reason for 'premium' shopping, 45.1% of consumers of 'premium' product raised a luxurious feeling, 37.4% because of deliciousness and 25.6% for the purpose to reward oneself*[11]*. Interestingly, 'premium' product consumers prioritised the 'taste' as a better value than the 'price'. It is suggested that the sensory satisfaction becomes an investable point among the future consumers.*

The prevalence of "premiumisation" has given lead to confectionery food and desserts, beer, ice cream, coffee, bread to date. Further, condiments such as mayonnaise, or ketchup, and the beauty care products have recently entered the market. It is suggested the 'premium' market will be growing in product varieties and customer classes. Surprisingly, 'premium' boom has been extended to private brand (PB), which is well-known for selling 'cheap' products. PB has begun to launch 'premium' items for slightly higher price than the original PB products but cheaper than other non-PB products. This somehow shows a possibility that 'premium' food distribution might reach out every corner of Japan.

c) Weakness to word 'Limited'

Are Japanese vulnerable to the word 'limitation'?

Regardless of customer's age and gender, season, and location, Japanese consumers are commonly submissive to 'limited' sales. In the shops, the typical sale promotions that can be found frequently are 'seasonal edition', or 'this week only, 'Tokyo special' etc. According to the survey, 79.3% of Japanese consumers buy 'limited edition' products in their daily lives[12]*. Seasonal campaign is a privileged promotion in Japan where there are distinct four seasons. Packages of food are decorated with patterns and colours matching to the season. Also, tastes and flavours of the food are specially made to offer seasonal atmosphere. The sales for a limited period are normally shorter than* *seasonal sale but offering discounts or sound deals. When coming back from a trip, or visiting friends or relatives living in different regions, products sold only in a specific region are quite popular gift. Due to the gift-exchange custom in Japan, local sweets and desserts are the best-selling souvenirs [13].*

In other countries that also have periodical sales and temporary promotions, these seasonal events are rather limited to festival-like occasions like Christmas, New Year, and Valentine's Day, and the major motivation to purchase a limited edition is different. Their purchase is mainly to celebrate such events or parties. On the other hand, Japanese consumers purchase limited editions as attracted by the word 'limit' (65.8%) or they felt they won't be able to get the product (49.4%) [14], and 49% of consumers just wanted to try buying one[14]. As described in the survey results, Japanese consumers tend to pursue special spending. It is not an organised expenditure on a special day for certain event, but it is closer to impulsive purchase.

B. Respect nature

a) Feel seasons in food

The seasons in Japan are so beautifully distinguished into four, spring, summer, fall, and winter. Each season offers different horticultural crops in the best qualities and quantities. Wisely, Japanese cuisines employ the country's blessing of seasonal ingredients in the seasonal preparation. One good example is 'hassun' the second course in a traditional multi-course Japanese dinner. It sets the seasonal theme in the use of one kind of fish and several smaller side dishes made of seasonal harvests. It is also characteristic that the season can also be felt with the eyes, such as expressing the season with plates and bowls or with garnishes, or decorating flowers of the season.

Seasonal changes also can be felt in processed food. When the season changes, m any new seasonal products are released. For examples, coffee shops in Japan launc h cherry blossom-flavored latte in spring. Strawberry, chestnuts, sweet potato are

Japanese favorite seasonal flavors for snacks and beverage.

Overall, the outstanding popularity of seasonal products shows the country's uniq ue trait. Even though greenhouse technology allows any crops and plans available throughout the whole year, and warming and cooling systems enable people stay a t a steady temperature; Japanese are likely to enjoy and appreciate the clear change of the seasons.

b) Taste each ingredient

Respecting authentic taste of each ingredient is a notable manner in Japan. For instance, to properly eat sliced raw fish, "sashimi," people add nothing but only a pinch of 'wasabi' and few drops of soy sauce. Another example is the way to eat a one-bowl dish. In many countries, one-bowl dish, which served with several ingredients in one bowl, needs mixing homogeneously before eating, such as taco bowls, pasta or 'bibimbab,' in Korean cuisine. Interestingly, Japanese usually do not mix up the whole bowl. Instead, they keep the bowl arrangement and eat the dish little by little. Some people explain they never want to intentionally ruin the color and shape of the original serving because they enjoy the food also with eyes.

Of course, Japan also has a one-bowl dish of steamed rice, called 'donburi,' which is served with proteins such as pork cutlets, marinated beef, or raw fish on top. However, we never find anyone who mix up 'donburi' before eating.

C. Ready-to-go

a) Convenience stores > Department stores

Regarding the number of outlet stores located across the country, Japan's convenie nce store is incomparable in the world. Based on 2015 statistics of JFA, 53,309 branches exist throughout the nation and 604.2 million customers were visiting per outlet in a year[15]*. A diversity of displayed products explains the rapid growth of* *convenience store in Japan. Fresh cooking ingredients are popular among increasing small-sized families who seek for easy and quick shopping within a walking distance. On the other hand, instant snacks like fried chickens, boiled fish cakes, and meat buns, etc. are young people's quick meal substitutes. It is true that convenience stores grew for previous decades by attracting young shoppers mainly. However, as the people living in rural area get older and lifespans increase in Japan, most of the convenience stores have changed their offerings to suit better the tastes and easy packaging to open for seniors. The recent statistics from Seven & I Holdings Co. showed that customers of age 50 or older, who represented only 9% of all the customers in 1989, reached to 30% in 2013. In that same period, people aged 29 and younger that accounted for 63% of daily customers before, decreased to about 29% in 2013*[16]*. This notable demographic change has influenced a lot to 'bento', a Japanese style lunch box and other ready-to-eat foods a lot. The bento, which used to target young customers with cheap, filling meals, has not yet been reformed to attract older shoppers who rather prefer bento with high quality and safe products, including healthy ingredients and the food stuffs that are either locally produced or from a renowned farms. For the future market, more and more convenience stores are selling products for senior customers together with improved services like home delivery, shopping support, and even nursing care consultation.*

Supermarkets in Japan are slightly different from those in the US or Australia. Local supermarket chains provide grocery items and very few house commodities because drug stores mainly in the charge of selling those items. Compared to convenience stores, supermarkets have more fresh and diverse choices in groceries. Besides, the size of processed foods is bigger for relatively lower price than convenience stores. Some supermarkets also sell some instant, ready-to-eat deli in a corner. They target busy mothers who want to support the variety of dishes on family table by adding few cooked dishes that are available at the supermarkets.

In Japan, department store also sells food. Typically, foods in department stores *include nicely-decorated confectionery products, the high-value delicatessen, expensive imports, all of which are suitable for gifts. Regarding because of the high price and less frequent necessity of the foods soled in a department store, and also because the low purchase confidence continued for years, department stores have been losing share in the total retails. As a result, the sales at department stores were overtaken by convenience stores in 2008* [17].

To summarize, the type of shops where people purchase the foodstuff has recently diversified according to their purpose. A convenience store is a place for quick and multi-solution purchase especially for singles, a supermarket is a place to buy for families with a reasonable price, and a department store is the place to buy high-quality items and to prepare gifts for some occasional greetings. Growing convenience shoppers and decreasing department store visitors may suggest how Japanese society becomes lonely and less interactive between among people.

b) 'Bento' culture

Under competitive profit-focused society, working hours continue to extend, and break time is not long enough to have a regular lunch as before. 'Bento,' that stands for lunch box in Japan, has become an essential meal solution for the meals in this busy lifestyle, like sandwiches in other countries. The increase of ready-made lunch box is mainly because that busy people have no enough time to go to a restaurant or preparing meals at home. Japanese 'bento' however has unusual form. It is served in a flat container divided into 5-6 parts, one for rice, another for protein-rich main dish, and the others are for side dishes. It may look like a copy of home-made meal just replaced in a box tray. Another interesting point of 'bento' is its availability at anywhere everywhere during lunch time. From street stalls, convenience stores to food delivery and catering, more and more food business seeks to enter 'bento' market. Japanese bento-style lunchbox is spreading out to overseas as a take-out format. In spite of the growing market, a problem in bento industry is a labelling system. Nutrition and ingredient information is not s *tandardized yet. Truly, concise policy and regulation are necessary for food safety and further expansion to the global market.*

A start of bento culture is based on school lunch box for the children that mom made early in the early morning with her love. However, such domestic custom i s no longer possible to be kept perhaps due to environmental changes to hectic s chedule and noisy lives. Bento in Japan not only serve a right amount of food a nd fascinating taste, but also console consumer's busy life through offering proper meal like a homemade one.

D. I Love Japan

a) Japanisation

What is amazing about Japanese people is their skill to adopt any foreign mater ials in such a way that the final product is not the direct introduction but is alte red in Japanese style. Under the previous policy of national seclusion (Sakoku) fo r over 250 years in the era of Edo until the Meiji Restoration, Japan had develo ped its own unique cultures and manners as an isolated island country. At the sa me time, this country had a chance to get contact with China and European coun try, mainly Netherland, to some extent and people had acquired the way to introd uce foreign matters into daily life in an extensively modified manner. Among the common food in Japan, there are lot of such modifications, including napolitan sp aghetti (spaghetti stir-fried with vegetables in ketchup), menchi katsu (deep-fried breaded hamburger), curry (thick and stew-like), omu-rice (ketchup-flavored rice c overed with omlet), and tonkatsu (deep-fried pork cutlet) all of which show how J apan introduced western food and developed as common Japanese cuisine. In othe r words, foreign authentic dishes could attract the Japanese market for a short p eriod but wouldn't be successful in long-term sales as it stand. Therefore, an este em and consideration on Japanese culture and taste, and flexible transformation may be necessary for the success of exporting new foods into Japan.

b) Patriotism

In Japan, there are some companies who can run a business within domestic market only. This closed market is not simply due to the absence of Japanese consumers who have well-established income, but that many people choose domestic products over foreign ones. Indeed, Japanese consumer's passion to use local domestic products is second to none in the world. According to the 2014 purchase intention investigation, the ratio of citizens concerning whether items are manufactured at domestic or overseas plants has increased yearly to reach 77.5%[18]. Even 35.6% of restaurant visitors are interested in the origin of foodstuff to be served. More than half of Japanese people perceive that domestic products are more expensive than imported ones but believe them much safer. The survey results suggest that 61.6% consumers said they are willing to pay for domestic products even though the price is 1-3 times higher. Among food items, the top ingredients that people adhere to national production are rice (77.4%), vegetables (69%), and mushrooms (64.2%). Unexpectedly, meat and fish were less obsessed.

After the Great East Japan Earthquake, some countries near to Japan or who were actively importing Japanese products became reluctant to consume food produced in Japan because of a concern about possible contamination with radioactive substances due to Fukushima atomic power plant crisis. In contrast in Japan, people still tend to purchase domestic products. The earthquake ruined lots of rural environment in affected area, but it didn't significantly alter the preference of Japanese consumers to local goods.

Instead of being a risk taker who always changes purchase by qualities and price they seek for, Japanese prefer sitting in a safe zone of familiarity. These patriotic attitudes against imported goods seem challenging for foreign exporters to get settled down at the food market in Japan.

These types of conclusive advices are highly paid to Mintel, Mckinsey report, Huffington post etc. or firm-customized consulting agency, suggesting the value of information is more than imagination.

(3) Market foresight

For company’s business, it is essential to predict what will have a long-run impact by marketing. To do that, a decision maker has to have appropriate foresight ability.

What is marketing foresight? It includes a full understanding of market trend and to set up the strategies which must prospect future growth of the business and timing to generate a big hit among predicted customers. As customers of these days are not obsessed with one item but change their tastes and keen to try new stuff, there are no such a structured, analytic, and reliable answers of marketing foresight. Meanwhile, the only answer is to keep evaluating a future customer category, predicting the future consumer based on case studies, and analyzing how consumer’s basic demands would change by time.

To explain in detail, I describe in three steps

First of all, it is essential to identify and quantify the users and their current needs in a target market. The data may include demographic and sales research on a certain product line, a segmented consumer category, and criteria of purchase motivation.

Second, it is necessary to find the future growth drivers and assess their impact. When anticipating results of future marketing, it is important to see trends and growth drivers within a particular product line. It must describe how consumers change their minds and purchase behavior. To do so, it is needed to obtain a complete data of socio-demographic, cultural, economic factors with linear graphs of trends.

The last step is to line up the previous trend products among the particular customers. Throughout the step one and two, some growth factors were found that equals to the reasons of consumer’s behavior.

Overall, companies should not be apart from consumer information. A trend may shifts rapidly than ever before. Therefore, companies must have a solid discipline in anticipating the market foresight to win in the complicated market competition [19].

In the present Problem-based Study, a new type of marketing study was carried out in order to get some foresight with Japanese consumer market. The texts below show the summarized foresight and advice to food manufacturing companies.

Japan is the third largest economic bloc after US and China in the world. Its market consists of consumers who have high levels of income, and well-developed transportation, technology, and a strong purchasing power in the market, which promotes the foreign traders to attempt business in Japan. However, many overseas companies are confronted with a strong domestic market walls. Especially, food is a sensitive and vulnerable item in Japan. More than 25% of disposable income is spent to buy food, indicating that food creates a significant portion of lifestyles in Japan.

Foreign businesses that plan to export food to Japan have to ensure their food products match enough with the Japanese lifestyles. This report discusses Japanese cultures, market trends, and consumer attitude to guide future exporters to develop market knowledge, and available strategies. The key points are summarized as follows;

1. Glocalise food products: balancing foreign and Japanese food features (taste, flavor, texture, appearance, package, and nutrition)

2. Special treatment: making consumers feel special through limited-target marketing, upgrading ingredient quality, launching on special events, etc.

3. CVS items: producing food for convenience store sale (mini-package, ready-to-go meal, microwavable processed food, etc.)

4. Sincerity: researching, processing, labeling, marketing and launching food products with utmost sincerity in the whole supply chain. Making food products like ‘home-

made.'

A market will be more clearly visualized as you look at consumer’s lifestyle, feeling deep inside of heart, and intended/unintended behaviors. I worked on this foresight to provide practically useful consumer’s information for foreign exporters to effectively approach Japan’s food market.

Sensory research

(1) Scientific evidence

Chemosensory research relating to the development of new food product is getting recognized these days. The acceptance of food commodities is tested in the early stage of sensory evaluation. However, the main international companies are highly interested in the science of olfaction and gustation, committing millions of dollars to chemosensory science. Now, the range of sensory research has expanded from consumer preference to applications of physiological and biochemical knowledge to the design of food component.

'Basic science' including physiology of central and peripheral nervous system, mo lecular biology of chemoreceptors, and the chemistry of odorants and tastants, are becoming essential approach in the food industry. Those lead to discovering new t echnologies and even an application for patents. For professional research, compani es now hire scientist and technicians or collaborate with academic institutions such as universities and public research centers. The findings obtained from basic scie ntific research shall be published in scientific journals that give reliability of new products. Ever since the education levels of consumers are high enough to search and study about what they consume, scientific approach becomes a critical factor o f great impact.

In the laboratory which I belong to, we have investigated the contribution of lip id receptor to sensory perception in mice. Here is a brief introduction to the basic chemosensory science.

The olfactory system is important for animals to determine (or judge) whether a given food is safe to eat and swallow or not. Fatty food and dietary oil produce a distinct odor by heating and cooking. The odor molecules and compositions are well understood however, understanding of the sensory perception in animals is insufficient. In our stu dies, a relationship between sensory receptor and animal behavior toward ligand molecules was investigated.

CD36 is a transmembrane protein that is involved in the recognition of certain amphipathic molecules such as polar lipids found in various tissues and body fluids. So far, CD36 homologues in insects have been demonstrated to be present on the surface of olfactory dendrites and to participate in the perception of exogenous compounds. However, little is known about the relationship between CD36 and mammalian olfaction. Indeed, the detection of only CD36 mRNA in the mouse olfactory epithelium has been reported to date. In my study, to provide potential evidence for the involvement of CD36 in mammalian olfactory perception, we extensively investigated the localization of this protein receptor in the mouse olfactory mucosa. In situ hybridization analysis using antisense oligonucleotides to CD36 mRNA detected aggregated signals within the deeper epithelial layer of olfactory mucosa. The mRNA expression was also detected consistently in the superficial layer of the olfactory epithelium, which is occupied by supporting cells. Immunostaining with ~~an~~ anti-CD36 polyclonal antibody revealed that CD36 localizes in the somata and dendrites of distinct olfactory receptor cells and that it occurs abundantly on the olfactory epithelial surface. However, immunoreactive CD36 was rarely detectable in the nerve bundles running in the lamina propria of olfactory mucosa, the axons forming the olfactory nerve layer in the outermost layer of the bulb and axon terminals in the glomeruli. We also obtained electron microscopic evidence for the association of CD36 protein with olfactory cilia. Altogether, it was suggested that CD36 plays a role in the mammalian olfaction. In addition, signals for CD36 protein were detected also on or around the microvilli of olfactory supporting cells and the cilia of nasal respiratory epithelium, suggesting a role for this protein other than olfaction in the nasal cavity.

Further, we also assessed whether CD36 is involved in sensing the oxidised phospholipid species, by using animals administered consciously with a ligand of CD36, 1-(palmitoyl)-2-(5-keto-6-octanedioyl) phosphatidylcholine (KOdiA-PC). We found *that mice avoided or hesitated to ingest fluids containing KOdiA-PC, suggesting the presence of distinct perception of different lipid species in the animal. We ass essed the involvement and role of CD36 in the KOdiA-PC perception by comparin g the behavioral responses of wild-type and CD36-deficient mice to the test fluids, and provided evidence that the protein could play a role in sensing a minute lev el of the lipid. We also found that transection of the olfactory nerve of wild-type mice resulted in an inability to perceive KOdiA-PC, suggesting the significance o f olfactory system in the lipid sensing. Our findings, coupled with the recent findi ng of CD36 expression in the mouse olfactory epithelium, led us to predict that t he site of CD36 action in the KOdiA-PC sensing plausibly lies within the nasal c avity of the animal.*

Overall, we suppose that CD36 contributes mammalian olfaction and odorant-ind uced feeding behavior.

The findings obtained in this study focusing on a ligand-receptor binding in animals may be further applied to the approach in the new food development. As it became clear now that there is an olfactory sensor protein detecting lipophilic molecules, meaning mammals can smell and detect the different species of oil/fat, it may be possible to modulate the flavor of fatty food to increase palatability or decrease dislike impression.

(2) Product quality attributes

Commonly, quality attribute analysis refers to the science of quality perception that is the requirements for satisfy satisfying the consumers’ expectation. The requirements include not just sensory attributes but also non-sensory attributes for food products. For instance, food safety, processing, nutrition, and package are the non-sensory attributes, and the size, appearance, taste, aroma, or texture is sensory characteristics [20].

- ✓ Scheme of food safety determines the probability of continuous purchase or quitting further consumption. Even if there is no apparent evidence for causing any physical problems, unfamiliarity to food properties may induce an avoidance of the product.

- ✓ Interest in nutritional values is growing annually regardless of demographic difference. Recently, the food industry has concentrated to the innovation which is based on nutritional needs. If two items are the same except for the content of vitamines, there is no doubt that the consumer chooses the vitamin-fortified one.
- ✓ As lifestyles are getting busier, people select processed food rather than buying raw ingredient to cook. At the beginning of processed food industry, consumers merely considered its convenience for the purpose of time saving. Most recently, in addition to the convenience, consumers started considering whether processing technology is harmless or can keep original nutritional values.
- ✓ Aside from the appearance of food products, a package is another outlook representing food inside. A package enables to deliver information about the detail of food product and its quality before consumption. Moreover, a package is a product vehicle that must be chemically stable and environment-friendly.

Sensory attributes the most important factors that affect consumers' purchase. Because the five senses, vision, olfaction, gustation, audition, and somatic sensation, play ~~a~~ critical roles as a judge to determine whether the food is safe or harmful. The sensory evaluation perceived by the five senses is crucial to measure physiological and biological acceptance by consumers.

In the present PBL study, a sensory evaluation of Japanese consumers was conducted using nut bars which are rarely introduced so far to Japanese market. As all of the test subjects are not familiar with the sample food, it seemed that there is no bias formed by the previous experience among the test subjects. The detail of the research is as follows;

A. Purpose

In this project, we have tried to identify suitable sensory attributes for nuts & fruits bars. In Japan, consumer awareness of dried fruits & nuts is little, and their *distribution route is limited. Their usages are confectioneries and bread as a small portion ingredients rather than consumption themselves. Also, their prices are higher than peanuts, or even fresh fruits, so the consumption has not yet been increased. It is quite recent that dried fruits and nuts have expanded their diversities beyond almonds and raisins. As the high nutritional value of dried fruits and nuts, such as dietary fiber and abundant vitamins, has been recognized, the healthy image has been attracting consumers who have health-consciousness and cosmetic interests. Some health-promoting effects such as cholesterol-reducing activity by oleic acid (monounsaturated fatty acid), and slow digestion and effective dieting exerted by abundant dietary fiber have obtained a lot of attention of recent consumers for nuts as dietary supplements especially among women and young people. Dried fruits now in Japan are not only traditional items such as raisins and prunes, but also other kinds, such as mangos, figs, and berries are for sale in individual packages with a zipper that becomes convenient healthy snack.*

However, Japan shows still less consumption rate in dried fruits and nuts. It appears that the low consumption of dried fruits and nuts is due to the inconvenience and difficulty of eating recommended amount from zipper packs. In North America, Europe, and Oceania, it is easy to find nut bars or muesli bars that people consume between regular meals or as breakfast replacement. These products are portable and individually packaged for one serving which contains an appropriate amount of nuts and dried fruits for a meal. In contrast, these types of nutrition/energy bars are rare in Japan. When some products mention 'nuts and dried fruits included' on their packages, it mostly contains less than 5% of fruits or nuts. Instead, they have the texture of brownie or cookies and sweetness. This is because that people imagine the bar snacks as sweets to be consumed between regular meals.

Even though it is not a common form of nutrition bars in Japan, it may be ideal to supply a good quality of dried fruits and nuts products to Japanese consumers who are interested in improving healthy daily consumption. Thus, this project is planned to study the Japanese consumers' perception and attitude toward dried fruits and nuts bars for their breakfast.

B. Methodology of experiment and data analysis

To simultaneously collect information about consumer's background, appropriateness for specific sensory properties, hedonic ratings of food products and a sensory profile, we conducted a 'Check-all-that-apply' technique[21]. The published studies were referred to obtain detail protocols and choose justifiable subjects for our consumer test[22].

a) Consumer groups

The study was carried out with regular ordinary consumers who are untrained to evaluate realistic market trend. The consumers were recruited mainly at ~~the~~ Kyoto University. The consumer group consists of 100 students who volunteered to participate in this study. As this study is aimed to support healthy diet in young and busy population, recruitment was focused on subjects aged around 20~30s. All participants were confirmed that they have no food allergies, especially to nuts, and any fruits. The questionnaire was presented in Japanese. Gift cards were provided to appreciate the enrolment and cooperation.

This study got assessed by the Kyoto University Ethics Committee. Each consumer signed the consent document before the test. Participants were informed before the study that cooperation was entirely voluntary, that they can stop the test at any point/time. Their personal information was confidentially dealt, and their responses to the questionnaire remained anonymous.

b) Sample preparation and Test Environment

The Nutrition bars used for the sensory evaluation were transported via general transportation under a room temperature or below. Then, they were kept in the dark storage in Kyoto University under room temperature until use. The samples were cut into 15~20g in volume and set on a white paper plate. The test was conducted at room temperature with fluorescent light. Consumers were seated individually facing the walls, and there is a 0.5m distance between the test sample and each subject. Consumers were notified that they have different samples tested. Throughout the whole test sessions, consumers were banned to talk or share answers.

C) Appropriateness for specific sensory properties and overall hedonic ratings of food products

Each consumer received six nutrition bar samples in a sequentially monadic presentation to minimize systematic carryover effects. Each respondent received an evaluation sheet for each sample where they are asked to evaluate the perceived liking about the sensory property; appearance, taste, flavor, texture and overall on a 7point hedonic scales. Subsequently, each respondent answered a series of CATA questions with a variety of sensory characteristics which they found appropriate for describing the sample. Between samples, water was provided for mouth rinsing.

d) Consumer Background

After sensory evaluation, demographic and diet information was collected including gender, age, frequency of eating breakfast, and the frequency of nuts and fruit (including dried fruits) consumption per month. Psychographic questions are concerned about either product interest or general attitudes towards food. For instance, health consciousness, and willingness to try a novel food were also tested.

e) Data analysis

Univariate analyses were performed on the liking ratings on each sensory property and the overall hedonic ratings. Bonferroni tests were conducted to determine which pairs of samples are significantly different from each other. Cochran’s Q tests on each sensory CATA descriptor were performed to determine the statistic differences between samples in sensory descriptors. Differences are considered signifi *cant when* $P<0.05$.

C. Results and discussion

a) General data

The majority of the panelists were male (62%). Also, 49% of the panelists were between 24 and 26 years old, and 39% were between 23 and 25 years old. Furthermore, 51% of the panelist reported that they consume nuts once or twice a month, 21% once or twice a week, and 23% never. Also, 32% of the panelist answered that they eat fruits including dried fruits 1-2 time a month, 37% 1-2 times a week, and 23% almost daily. Fruit consumption is not as low as nut consumption in Japan.

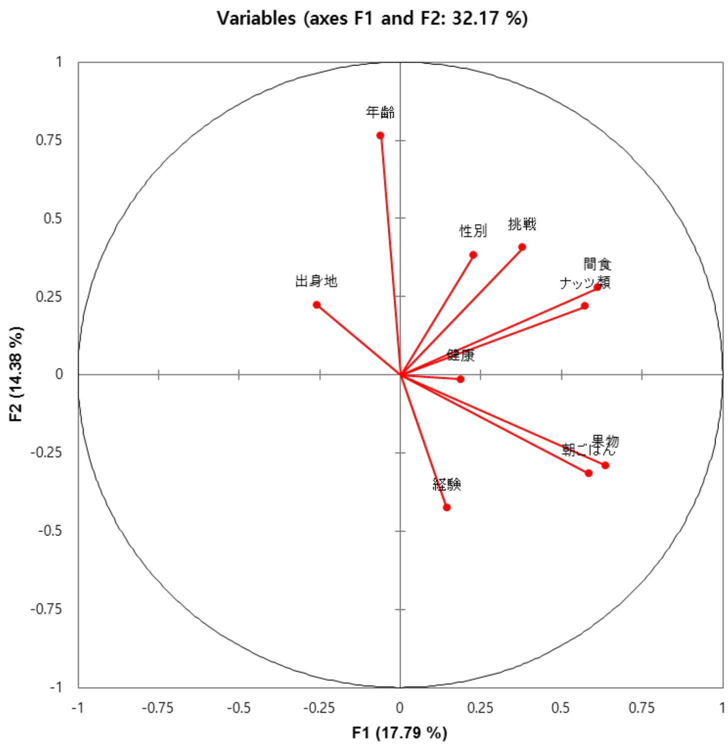

Fig. 1 Correlations between variables and factors: age, gender, hometown, frequencies of having breakfast, snacks, nuts, fruits, experience of eating nut bar, health consciousness, willingness to challenge new food.

We also surveyed basic diet pattern of the panelists such as frequency of eating breakfast and snacking between meals. Among the test subjects, 45% of the paneli *sts said they have breakfast daily, 36% 3-6 times a week, 10 % 1-2 times a week, and 9% never. Thirty four percent of the panelists said they have snacks daily or 5-6 times a week, 20% 3-4 times a week, 22% 1-2 times a week, and 19% never. To estimate a level of nut bar acceptance, we evaluated experiences of eating foo d like nut bars, and 68% answered yes, and the rest said no. In a survey regardi ng health consciousness, 82% of panelists said extremely or a little conscious, 1 7% normally not or barely aware, and the rest were at the average level of consc iousness. It seemed difficult for most of the enrolled individuals to give self-evalu ation on the consciousness by themselves. Therefore, many answered less expressiv e. Whether panelists are willing to challenge a new food or not was questioned, and 68% of them checked very or relatively willing to challenge and 31% never or rarely make a challenge. As their ages were young around the 20s, we anticip ated a high rate of challenging will, but the answer revealed far lower rate than expected.*

It is generally accepted that there is a correlation between frequency of eating breakfast and health consciousness, suggesting that product designed for breakfast must pay attention to the nutrition value of ingredients (Fig. 1). Also, we found that the frequency of eating snacks was proportional to the one of nut consumption (Fig. 1). This result possibly suggests that nut products can support Japanese diet as supplementary food. However, many participants explained that the snack foods they usually consume are with chocolates, jelly, biscuits, etc. Snack indicates a small food between regular meals in western countries and they bring fruits, whole grain crackers, almonds to eat in the afternoon. However, consumers in Japan perceive snack as a high-calorie, sugar–rich, and delicious food to entertain their palates and refresh from work stress. Therefore, it remains unclear whether Japanese consumers would have nut products for their snacking.

b) Acceptance test

All of the samples had sensory characteristics typical for nut bar and simultaneously *have significant traits for each. An outstanding gap was observed between well-accepted and avoided products. Overall acceptance was the most positive for sample 600 and the most negative for sample 726. Interestingly, overall acceptance is not always co-equivalent with acceptance for each sensory property. For instance, Sample 600 had the highest scores for texture and appearance while taste and aroma were similar to other samples. In contrast, sample 726 showed the worst scores for both taste and aroma, but scores for other properties remain standard.*

c) Check-all-that-apply (CATA)

The product characterization (Fig. 2) was generated from the total number of times that the consumers associated each of the 81 sensory terms of the CATA questions (Table. 1). The CATA analysis enables to differentiate the six samples and link each one to specific characteristics and identified based on sensory dimensions. The CATA results showed that the samples 148, 307, and 411 did not differ much regarding their images of functional, healthy, and sweetly fragrant. However, these samples were distinguished by the hard, nut and fruit contents, and bumpy surface of sample 411 and the well-balanced, granular texture, light, and crumbly for samples 148 and 307. Unfortunately, the sample 148 was poorly evaluated due to too crumbled and separated texture to grab to eat, being hardly imagined as a bar but closer to cereals.

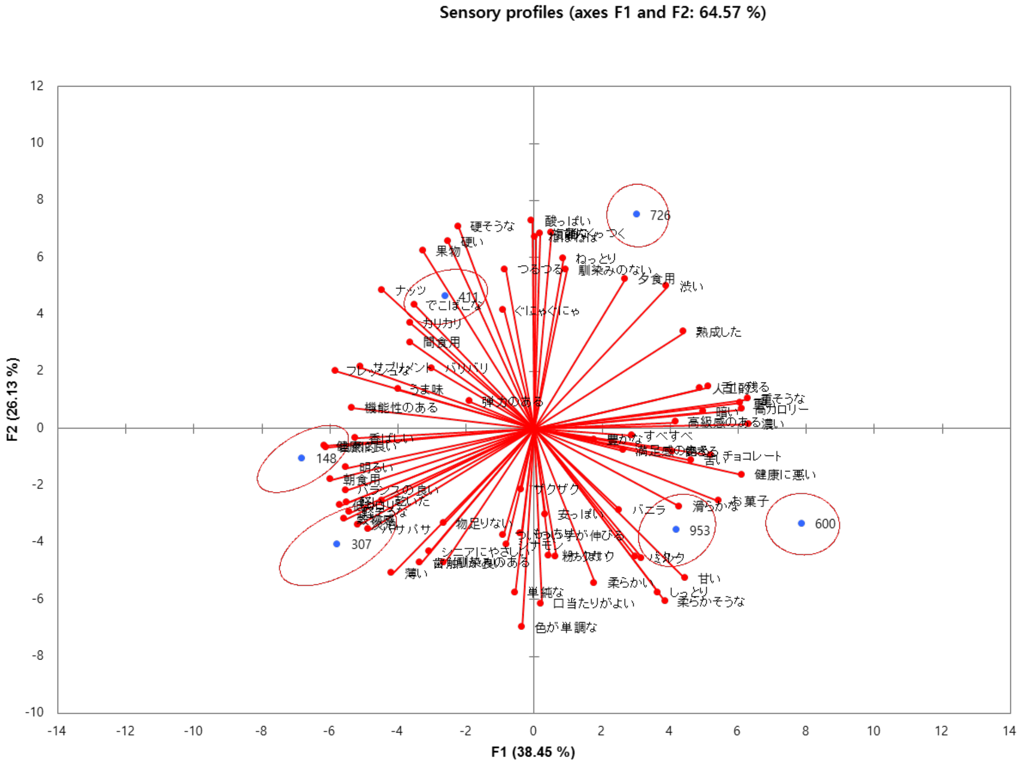

Fig. 2 The product characterization was generated from the total number of times that the consumers associated each of the 81 sensory terms of the CATA questions.

The samples 953 and 600 displayed numerous similarities such as images of snack-like and unhealthy, sweet taste and smooth surface. Nevertheless, sample 600 scored the top among six samples while sample 953 marked low acceptance level. It could be from the sample 953 represents unfamiliar flavors that some participants portrayed typical American junk food smell. This sample was like cookie dough which Japanese never eat. On the other hand, sample 600 soaked and covered by chocolate was told to remind of chocolate brownie, which is universal food even in Japan. We expected the chocolate flavor attributed to sample positively contributes to sample's acceptance always. Interestingly, the sample 726 half of which coated by chocolate was picked for the worst among six samples. We assume the acidic and complicating tastes contributed to its lower acceptance score. We found the top two samples, 600 and 307, have many different characteristics in color, image, and concept. Sample 600 represents, high in calorie, dark color, and product concept or snack. In contrast, sample 307 is associated with bright color, light c *alorie, healthy image, and product good for breakfast. Two samples were positivel y accepted but must target different consumer groups.*

外観	風味		食感		食べた印象	イメージ
明るい	甘い	チョコレート	歯触りが良い	しっとり	高級感のある	健康に良い
暗い	苦い	バニラ	つるつる	舌に残る	安っぽい	健康に悪い
色が単調な	渋い	果物	弾力のある	パサパサ	バランスの良い	機能性のある
硬そうな	酸っぱい	ナッツ	サクサク	粉っぽい	複雑な	高カロリー
柔らかそうな	塩辛い	濃い	口当たりがよい	滑らかな	単純な	低カロリー
でこぼこな	うま味	薄い	パリパリ	もっちり	フレッシュな	子供にやさしい
すべすべ	淡泊	穀物感	柔らかい	ふんわり	熟成した	シニアにやさしい
滑らかな	豊かな	ミルク	カリカリ	乾いた	満足感のある	朝食用
重そうな	香ばしい	豊かな	ねばねば	ぐにゃぐにゃ	物足りない	昼食用
軽そうな		バター	硬い	歯にくっつく	馴染みのある	夕食用
			ねっとり	ザクザク	馴染みのない	間食用
					ついつい手が伸びる	お菓子
					飽きる	サプリメント
					重い	人工的
					軽い	自然的

Table. 1 The 81 sensory terms of the CATA questions

We evaluated acceptance for each sensory property, then analyzed which descript ive words were positively perceived (Fig. 3). Bright color for appearance and cho colate, sweet, granule, nut and fruit flavors were evaluated to contributors for a high hedonic level and crispy and crunch in out layer and mild in inner side wer e expected texture for nut product. We anticipated that calorie and ingredients we re the main concerns among participants, since Japanese who are known to be st rict on food safety and health. But, there is no such a rule that Japanese only p refer unsweet, non-heavy, and rich in nutrition foods.

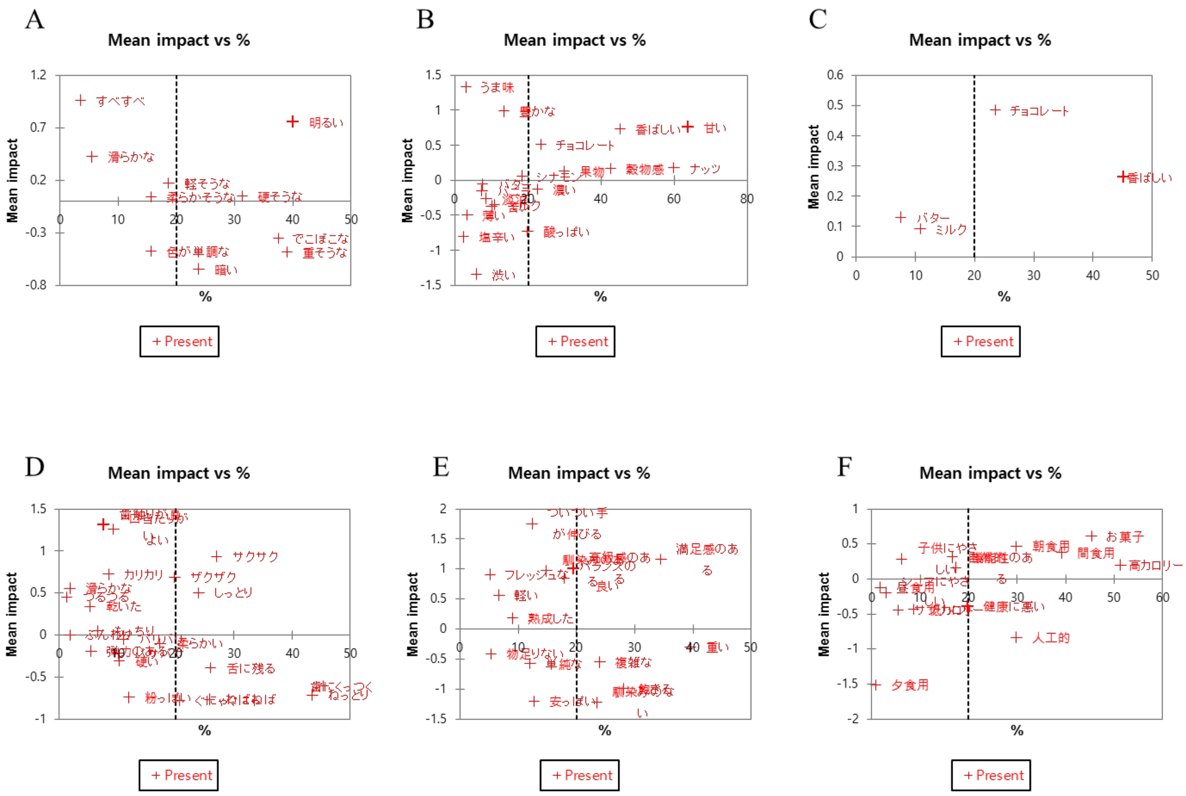

Fig. 3 The descriptive words of sensory attributes contributing positive acceptance levels. A: appearance, B: taste, C: aroma, D: texture, E: impression, F: image.

There are plenty of reports that differs samples by instrumental parameters and illustrate by gauged numbers. However, it is unavoidable to check how consumers perceive. Therefore, sensory analysis using CATA was used and that allowed us to define appropriate description expressed by consumers. In order to obtain more objective and accurate results, survey using more numbers of participants is to be done.

Conclusion

In this article, we emphasized consumer-oriented perspective when marketing a new product in a unique consumer group. Competition within the food industry is increasing as manufacturing technique and ingredient trading have been developed over time. More importantly, marketing tools and feedback pathway become diverse. Consequently, manufacturers and product developers keep receiving reviews, and the network system permits consumers observes companies as well as functions easy marketing means. It may not be an overexpression to say that consumers have a key of market competition. Indeed, a focus on consumers helps companies gain an outstanding competitiveness.

It could be emphasized that how the application of sensory evaluation encourages successful product development. A traditional marketing strategy based on demographic numbers or trend foresight cannot bring practical guides to R&D. Also, testing consumer of current condition in a local market connect consumers to companies in depth. The implementation of the multidisciplinary approach will be increasingly required to catching what target consumers like and purchase.

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