

AMERICAN CONSUMERS' EATING PATTERNS OF FISH AND KNOWLEDGE OF FISH RICH IN OMEGA-3 FATTY ACIDS

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ABSTRACT

Research on omega-3 fatty acids of marine origin indicates the value of these substances to human health, while seafood processors face the challenge of creating value-added products rich in omega-3 compounds that consumers identify as being both healthful and tasty. In particular, albacore tuna is considered to have large potential for such applications. Hence, the present research aimed at assessing the potential demand of U.S. consumers for fish products with high omega-3 content; a second aim was to investigate the impact of health-related information on written descriptions of albacore tuna dishes, with the long-range goal of developing predictive models of consumer acceptance of fish products for the seafood industry. Two hundred American adults who regularly eat fish were recruited in the Portland, Oregon, area. They completed an Internet survey assessing demographics, fish consumption patterns and knowledge of omega-3. Information about health benefits of omega-3 was introduced for half of the participants to determine whether it would induce greater acceptance of written descriptions of albacore tuna dishes. Providing such information enhanced consumer acceptance. In addition, familiar seasonings enhanced acceptance of dishes while familiarity of cooking method had a similar effect on consumer acceptance. US consumers were found to be generally unaware of the actual food sources and fish species rich in omega-3. Consequently, new fish products high in omega-3 fatty acids will not be associated with providing health benefits unless consumers are better educated about dietary sources of omega-3 and the specific health properties of these fatty acids.

Keywords: omega-3 fatty acids, albacore tuna, familiarity, consumers, United States, food acceptance.

INTRODUCTION

Health benefits of long-chain omega-3 polyunsaturated fatty acids

Long-chain omega-3 polyunsaturated fatty acids (referred to as omega-3 LC PUFAs in the remainder of this article), mainly eicosapentaenoic acid (EPA) and docosahexaenoic acid (DHA), are primarily found in seafood. They have been the object of extensive research regarding their role in human health, especially in the past 25 years, and were found to lower cardiovascular risk factors through various mechanisms of action [1]. Other benefits include lower risk of cancer, depression, asthma, obesity, autoimmune disease, Alzheimer's disease and osteoporosis [2,3]. Encouraging the regular intake of omega-3 PUFAs is thus part of a responsible public health policy, especially in countries (including the United States) where the leading causes of morbidity and mortality are linked to diet [1].

Justification for product development with juvenile albacore tuna

While the demand for value-added seafood products is rising in developed countries due to their healthy image [4,5], U.S. seafood processors face the challenge of creating value-added products rich in omega-3 compounds that consumers identify as being both healthful and tasty. In this context, albacore tuna (*Thunnus alalunga*) presents a potential waiting to be cultivated for the following reasons. **First,**

albacore tuna is high in omega-3 LC PUFAs. **Second**, juvenile albacore troll-caught in the Northern Pacific Ocean are abundant and have lower mercury content than their older, larger, long-line-caught counterparts. **Third**, troll-caught albacore tuna is a sustainable fishery with no by-catch problem [6]. **Fourth**, albacore products currently marketed do not offer much variety besides cans, pouches, fresh or frozen unseasoned meat, and tuna salad sandwiches sold at fast-food or casual restaurants. Also, tuna processed in large canneries are precooked before being canned, which results in a loss of omega-3 PUFAs. In sum, the potential of value-added albacore tuna products lies in troll-caught juvenile fish processed so that omega-3 FA content is preserved and seasoned to the taste of consumers.

Consumer information valuable for conception of value-added albacore tuna products

Preliminary to conceiving and promoting such products, several aspects of consumers' attitudes towards foods as well as seafood consumption need to be investigated. More specifically, assessment of eating habits, nutritional knowledge related to seafood, and attitudes towards albacore tuna will provide the food choice context in which new albacore products need to find their niche.

In addition, measuring the effect of nutritional information and types of seasoning/cooking method on consumer acceptance of these products may provide insight as to future product development and marketing strategies. Nutritional information has been found to impact one or several measures of consumer acceptance (e.g., willingness to try and liking of foods) among individuals to whom such information is relevant [7,8]. Given the negative impact of obesity on health and the increasing proportion of overweight individuals in the U.S., information on health benefits of omega-3 and presentation of albacore tuna as a source of omega-3 is likely to be relevant to the majority of the U.S. population and thus to impact consumer acceptance. Furthermore, recent studies suggested that the consumption of novel foods may be encouraged by the use of familiar flavor principles in their preparation [9,10]; flavor principles are the characteristic seasonings used in various cuisines [11].

To this end, the present research measured U.S. consumers' seafood consumption patterns, attitudes and knowledge of omega-3 health benefits. Furthermore, information on health benefits of omega-3 FAs, types of seasonings and types of cooking methods were manipulated to assess acceptance (willingness to try and expected liking) of written descriptions of dishes using albacore tuna as main ingredient, with the long-range goal of developing predictive models of consumer acceptance of fish products for the seafood industry.

Study goal and research questions

The study aims at describing the profile of U.S. consumers in terms of their demographics, fish eating patterns, knowledge of omega-3 FAs, and attitudes to albacore tuna. A second aim is to test whether providing information to consumers on the health benefits of omega-3 in albacore tuna will result in higher acceptance of albacore tuna dish descriptions than when such information is not provided. The third aim is to determine whether dishes with familiar seasonings and cooking methods will receive higher acceptance ratings than those with novel seasonings and cooking methods.

METHODS

Participants

Two hundred consumers above the age of 18 were recruited in the Portland Metropolitan Statistical Area (Oregon, U.S.A.). Criteria for inclusion in the study were: fish consumption once a month or more often, the United States as country of birth, and residency in the U.S.A. for the past 10 years and for at least 13 of the first 15 years of life.

Survey procedure and design

The survey was a self-administered questionnaire to be completed over the internet in a single session. Participants accessed the survey website at a time and location of their choice, and the average duration of sessions was 25 to 30 minutes. Survey questions pertained to demographics, seafood and albacore consumption patterns, knowledge of omega-3 fatty acids, and acceptance of written descriptions of dishes using albacore as a main ingredient. Table I details the measures corresponding to these areas of investigation.

Table I: Survey measures

Demographics
Gender, Age, Ethnicity Income level, Education level, Household size, shopper status (principal grocery shopper: Yes/ No/ Share equally with someone else)
Seafood and albacore consumption patterns
Fish Consumption Frequency Reported Liking of Fish (7-point category scale) Breadth of Fish Species Consumed (number of different fish species consumed in past year) Non-Canned and Canned Albacore Consumption Frequency
Knowledge of omega-3 fatty acids
Exposure to omega-3 FA information (read/heard about it: Yes/ No/ Don't know) Belief pertaining to mega-3 FAs (good for health/ bad for health/ neither/ don't know) Identification of foods high in omega-3 fatty acids among a list of 12 foods (meat, fish, vegetal items)
Acceptance of written description of albacore tuna dishes
Willingness to try (7-point categorical response scale to question "How willing would you be to try this dish?") Expected Liking (7-point categorical response scale to question "How much do you expect to like this dish?")

Participants were randomly assigned to one of two groups. Group 1 rated written descriptions of albacore tuna dishes in terms of willingness to try and expected liking (using seven-point categorical scales) without any additional information on albacore tuna and omega-3 fatty acids, other than their prior knowledge on the subject. Table II shows an example of a written dish description and its accompanying questions and response scales.

Table II: Example of a survey question pertaining to one albacore tuna dish description

<p>Grilled albacore tuna with rosemary and garlic seasoning:</p> <ul style="list-style-type: none"> • How willing are you to try this dish? <ul style="list-style-type: none"> ○ Not at all=1, 2, 3, 4, 5, 6, 7 =Very much • How much do you expect to like it? <ul style="list-style-type: none"> ○ Not at all=1, 2, 3, 4, 5, 6, 7 =Very much

Group 2 rated the same dishes after being presented with a paragraph describing albacore tuna as a fish high in omega-3 fatty acid content and the main health benefits of these fatty acids (Table III). Cooking method was held constant ("Grilled"), while seasonings were manipulated in the dish descriptions. Seasoning was a within-subject variable with two levels (familiar and novel). Willingness to try and expected liking of dishes were the two dependent variables representing consumer acceptance.

Table III: Information provided to experimental groups

<u>Group 1</u>	<u>Group 2</u>
No Information on health benefits of omega-3 fatty acids contained in albacore tuna	Information provided before rating of dishes: “Albacore tuna is a good source of omega-3 fatty acids, which may help: <ul style="list-style-type: none"> • Control cholesterol level • Lower the risk of cancer, heart disease, osteoporosis • Prevent obesity and high blood pressure”

Albacore dish stimuli

A pilot survey was conducted before the main study in order to assess the frequency of use of various seasonings (SN) and cooking methods (CM) in fish dishes. For the purpose of the present study, the assumption was made that frequency of use paralleled level of familiarity, in the sense that most frequently used SN or CM were also the most familiar to consumers. Two levels (“Familiar” and “Novel”) of CM and of SN were used to create descriptions of albacore tuna dishes. The familiar SN followed a familiar, Western flavor principle, and the novel SN followed an unfamiliar, Japanese flavor principle. Table IV summarizes the familiar and novel SN and CM that were used in the study.

Table IV: Seasonings and Cooking Methods Used in Main Study

	Familiar	Novel (to U.S. consumers)
Seasonings	Rosemary / Garlic	Kombu (kelp) / katsuobushi (dried bonito flakes)
Cooking Method	Grilled	Steamed

Each participant was presented with the four resulting dish descriptions. The description of the dish using SN and CM that are both novel is “Steamed albacore tuna with kombu (kelp) and katsuobushi (dried bonito flakes) seasonings”.

RESULTS

Sample characteristics

Eighty-two men and 118 women completed the survey. Their ages ranged from 19 to 64 with a mean of 32.7 (SD = 11.3).

Most individuals were Caucasian (85.0% - see detailed ethnicity distribution in Table V).

Education level ranged from “high-school graduate” to “graduate degree (Master’s, Ph.D., etc)”, with 74% of respondents having some college education or a college degree and 23% having a graduate school education or a graduate degree.

Principal grocery shoppers and “shared responsibility” shoppers represented 90.5% of the sample (54% and 36.5%, respectively). While genders were approximately equally represented among “shared responsibility” shoppers (38 women and 35 men), 69.4% of principal grocery shoppers were female and 73.7% of “non-grocery-shoppers” were male (Pearson Chi-Square = 14.72, df = 2, p = 0.01). Household sizes ranged from 1 to 9, with the majority of respondents living in one- and two-member households (24 and 39%, respectively). Income levels from \$0 (mostly students) to over \$100,000 were represented, with the median income category being \$35,000~49,900 (c.f., Table V).

Table V: Ethnicity and income characteristics of sample

Ethnicity: number of individuals (percentage of sample)	
<ul style="list-style-type: none"> • <u>Caucasian</u>: 170 (85.0%) • <u>American Indian/Alaska Native and Caucasian</u>: 5 (2.5%) • <u>Black/ African-American</u>: 4 (2.0%) • <u>Hispanic/ Latino</u>: 4 (2.0%) • <u>Asian</u>: 9 (4.5%) • <u>Declined Response</u>: 8 (4.0%) 	
Income: number of individuals (percentage of sample)	
<ul style="list-style-type: none"> • <u>\$0 to \$14,900</u>: 11 (5.5%) • <u>\$15,000 to \$24,900</u>: 35 (17.5%) • <u>\$25,000 to \$34,900</u>: 31 (15.5%) • <u>\$35,000 to \$49,900</u>: 27 (13.5%) • <u>\$50,000 to \$74,900</u>: 31 (15.5%) • <u>\$75,000 to \$100,000</u>: 40 (20.0%) • <u>Over \$100,000</u>: 17 (8.5%) • <u>Declined response</u>: 8 (4.0%) 	

Fish and albacore consumption patterns are shown in Table VI. Respondents consumed on average 7-8 fish species/categories during the past year, and most ate fish less than once a month. A majority of individuals reported eating canned albacore tuna once a month or more often, while less than 50% of respondents reported eating non-canned albacore with such frequency. 89.5% of respondents reported liking fish “moderately” or “very much” (positive extreme of the 7-point response scale).

Table VI: Fish and albacore consumption patterns

Fish consumption frequency: number of individuals (percentage of sample)	
<ul style="list-style-type: none"> • <u>1-2 times a month</u>: 47 (23.5%) • <u>3-4 times a month</u>: 101 (50.5%) • <u>2-3 times a week</u>: 44 (22.0%) • <u>3 or more times a week</u>: 8 (4.0%) 	
Breadth of fish species/categories consumption during the past year (among a list of 22 items)	
<ul style="list-style-type: none"> • <u>Range of fish species consumed</u>: 1-17 • <u>Mean</u>: 7.66 • <u>Standard deviation</u>: 3.40 	
Albacore tuna consumption frequency: number of individuals (percentage of sample)	
Non-canned:	Canned:
<ul style="list-style-type: none"> • <u>Never/Less than 3 times a year</u>: 51 (25.5%) • <u>Less than once a month</u>: 53 (26.5%) • <u>1-2 times a month</u>: 50 (25.0%) • <u>3-4 times a month</u>: 27 (13.5%) • <u>2-3 times a week</u>: 4 (2.0%) • <u>3 or more times a week</u>: 1 (0.5%) • <u>Unsure</u>: 14 (7.0%) 	<ul style="list-style-type: none"> • <u>Never/Less than 3 times a year</u>: 21 (10.5%) • <u>Less than once a month</u>: 40 (20.0%) • <u>1-2 times a month</u>: 66 (33.0%) • <u>3-4 times a month</u>: 55 (27.5%) • <u>2-3 times a week</u>: 15 (7.5%) • <u>3 or more times a week</u>: 2 (1.0%) • <u>Unsure</u>: 1 (0.5%)

86% of participants had read or heard about omega-3 fatty acids, and 82% believed these FAs to be good for health. Despite this widespread exposure to omega-3, knowledge of dietary sources is inaccurate. Indeed, when asked to identify foods high in omega-3 in a 12-item list (see Table VII - 4 types of meats, 4 fish species, 4 vegetal items, and a “Don’t Know” option), only 8.5% of respondents correctly identified **salmon, tuna and halibut** (Table VIII), while 20% selected all four fish items (sole was the

fourth fish item). Despite the fact that no vegetal or meat items listed were high in omega-3, 25.5% of consumers selected at least one item in these categories.

Table VII: List of items used in consumers’ identification of foods high in omega-3 FAs

Beef	Salmon	Coconut	Don’t Know
Chicken	Sole	Garlic	
Pork	Tuna	Corn	
Lamb	Halibut	Broccoli	

Table VIII: Pre-existing Knowledge pertaining to omega-3 FAs

Exposure to omega-3 FAs (percentage of sample who read/heard about them)
<ul style="list-style-type: none"> • Yes: (86.0%) • No: (9.5%) • Unsure: (4.5%)
Belief about omega-3 FAs
<ul style="list-style-type: none"> • Good for health: (82.0%) • Bad for health: (3.5%) • Neither good nor bad: (1.0%) • Don’t know: (13.5%)
Foods identified as high in omega-3 FAs: number of respondents
<ul style="list-style-type: none"> • Vegetal items only: 3 (1.5%) • Meat and vegetal items: 4 (2.0%) • Fish items only: 112 (56.0%) <ul style="list-style-type: none"> ○ All 4 fish items listed: 40 (20.0% of total) ○ Salmon + Tuna + Halibut: 17 (8.5%) ○ Two fish items rich in omega-3, without Sole: 22 (11%), 20 being {Salmon + Tuna} ○ One fish item rich in omega-3, without Sole: 28 (14%), 26 being {Salmon} ○ Other combinations of fish items: 5 (2.5%) • Fish and meat items: 3 (1.5%) • Fish and vegetal items: 36 (18.0%) • Fish, meat, and vegetal items: 5 (2.5%) • Don’t know: 37 (18.5%)

Effects of provided information and familiarity of dish ingredients on acceptance

No statistically significant difference was found between the two information groups in terms of demographics, fish consumption/liking, and pre-existing knowledge about omega-3 fatty acids (Pearson Chi-square for gender, t-test for independent samples for age, and Kolmogorov-Smirnov Z for other variables; $p > 0.20$). Consequently, we proceeded with the comparison of the two groups through a 2x2 ANOVA with information group as the between-subject variable and seasoning familiarity as the within-subject variable.

Table IX shows the mean acceptance scores according to Information groups and levels of familiarity of dish descriptions. Presentation of information on health benefits of omega-3 and on albacore tuna as a source of omega-3 resulted in significantly higher expected liking scores than when no information was provided ($F(1,198) = 4.299, p < 0.05$); impact of providing information was marginally significant on willingness to try ($F(1,198) = 3.887, p = 0.05$). Main effects of cooking method (CM) and seasonings (SN) on consumer acceptance were significant. Consumer acceptance of albacore dishes using the familiar CM (“Grilled”) was higher than that of dishes using the novel method (“Steamed”), with values

of F(1,198) equal to 14.231 and 42.843 for willingness to try and expected liking, respectively (p<0.01). Similarly, acceptance was higher for dishes using familiar SN (“rosemary and garlic”) than for those using the novel “kombu and katsuobushi”, with F(1,198) = 15.231 and 59.681 for willingness to try and expected liking, respectively (p<0.01). Interaction effects of CM and SN on consumer acceptance were statistically non-significant.

Table IX: Mean consumer acceptance scores (and standard deviations) according to information condition and (CM, SN) combinations

(CM, SN) combinations	Group 1: No Information		Group 2: Information Provided	
	Willingness to try	Expected Liking	Willingness to try	Expected Liking
Familiar CM/ Familiar SN	6.02 <i>SD = 1.51</i>	5.85 <i>SD = 1.40</i>	6.33 <i>SD = 1.29</i>	6.13 <i>SD = 1.27</i>
Novel CM/ Familiar SN	5.68 <i>SD = 1.76</i>	5.37 <i>SD = 1.60</i>	6.16 <i>SD = 1.34</i>	5.80 <i>SD = 1.36</i>
Familiar CM/ Novel SN	5.67 <i>SD = 1.84</i>	5.17 <i>SD = 1.80</i>	6.00 <i>SD = 1.54</i>	5.53 <i>SD = 1.64</i>
Novel CM/ Novel SN	5.43 <i>SD = 1.87</i>	4.69 <i>SD = 1.71</i>	5.89 <i>SD = 1.46</i>	5.19 <i>SD = 1.57</i>

DISCUSSION

Knowledge of dietary sources of omega-3 FAs was found to be inaccurate among U.S. consumers, which implies that new albacore products high in omega-3 fatty acids are unlikely to be associated with providing health benefits unless consumers are better educated about sources of omega-3 FAs.

The impact of information on omega-3 FAs on willingness to try and expected liking of written descriptions of albacore dishes suggests that package labels bearing such information may enhance purchase intent and eventually consumption of value-added, seasoned albacore tuna products, provided that consumers actually read the information. Furthermore, the finding that acceptance is enhanced towards dishes using familiar cooking methods and seasonings emphasizes the importance of cultural background and exposure to flavor principles in consumers’ decisions about products that are already cooked and seasoned.

Consequently, value-added products made with juvenile albacore tuna call for a public information campaign emphasizing BOTH the health benefits of this fish high in omega-3 and low levels of harmful mercury relative to other tuna. This is supported by the authors’ preliminary findings that similarly to patterns of knowledge on omega-3, consumers’ awareness that mercury is bad for health does not widely coexist with knowledge that juvenile albacore tuna has lower mercury levels overall relative to more mature tuna. Labels on product packaging will reinforce the information delivered by media campaigns, although their influence is limited to those who actually read labels.

Finally, a caveat is that the present findings may generalize to college-educated Caucasian consumers in the Pacific Northwest region of the United States, although they may not apply to other ethnic and socio-economic groups. The possible reasons for the low participation rate of minorities are a low willingness to respond to surveys, a high proportion of recent immigrants in Portland who did not meet the recruitment criteria of the study, and/or a socio-economic status resulting in difficult access to the internet and computer technology.

CONCLUSION

The present findings were a first step towards determining the leverage variables of consumer acceptance with regards to albacore tuna products. Further insight on drivers of acceptance will be provided by findings from the Japanese counterpart of this survey study (data collection in process among consumers in the Tokyo area) and a comparison of the two datasets.

Given the increasing knowledge on interactions between the by-products of human activity/intervention and the natural environment from which food sources are derived, foods cannot simply be labeled “bad” or “good” any longer, because it only adds to the confusion of consumers. Juvenile albacore tuna is a good illustration of the need for nuanced information delivery, that is to say acknowledging beneficial and harmful characteristics and their relative weights on human health.

In particular, value-added products made with juvenile albacore tuna call for a public information campaign emphasizing BOTH the health benefits of this fish high in omega-3 and low levels of harmful mercury relative to other tuna. Indeed, preliminary findings by the authors suggest that similarly to patterns of knowledge on omega-3, consumers’ awareness that mercury is bad for health does not widely coexist with knowledge that juvenile albacore tuna has lower mercury levels overall relative to more mature tuna.

REFERENCES

- Nettleton, J.A., 2004, Increasing the consumption of long-chain omega-3 polyunsaturated fatty acids by Americans, *Testimony to the Joint USDA/HHS 2005 Dietary Guidelines Advisory Committee on Behalf of the Alaska Seafood Marketing Institute*.
- Nettleton, J.A., 1995, *Omega-3 fatty acids and health*, New York: Chapman and Hall.
- Simopoulos, A.P., and J. Robinson, 1999, *The omega diet: The lifesaving nutritional program based on the diet of the island of Crete*, New York: HarperCollins Publishers, Inc.
- Nair, G.K., 1997, Demand for value-added seafoods rising, *Agribusiness*, October 16, p. 13.
- Sloan, A.E., 2000, Reeling It In. *Food Technology*, 54(12), p. 22.
- Cox, S.P., S.J.D. Martell, C.J. Walters, T.E. Essington, J.F. Kitchell, C. Boggs, and I. C. Kaplan, 2002, Estimating population biomass and recruitment of tunas and billfishes, *Canadian Journal of Fisheries and Aquatic Sciences*, 59(11), pp. 1724-1735.
- Kahkonen, P., H. Tuorila, and H. Rita, 1996, How information enhances acceptability of a low-fat spread, *Food Quality and Preference*, 7, pp. 87-94.
- Tuorila, H., A. Andersson, A. Martikainen, and H. Salovaara, 1998, Effect of product formula, information and consumer characteristics on the acceptance of a new snack food, *Food Quality and Preference*, 9(5), pp. 313-320.
- Stallberg-White, C., and P. Pliner, 1999, The effect of flavor principles on willingness to taste novel foods, *Appetite*, 33(2), pp. 209-221.

Pliner, P., and C. Stallberg-White, 2000, "Pass the ketchup, please": familiar flavors increase children's willingness to taste novel foods, *Appetite*, 34(1), pp. 95-103.

Rozin, E., 1973, *The Flavor-Principle Cookbook*, New York: Hawthorn Books.

ENDNOTES

The authors thank Dr. Michael Morrissey, Dr. Gilbert Sylvia and the Community Seafood Initiative for funding part of this research and for providing feedback and suggestions regarding the survey.