

# The Effect of Product Knowledge and Risk Perception on Consumers' Online Word-of-Mouth Search Behavior for the Bio-Agricultural Products—in the Case of Ganoderma Dietary Supplements

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**Abstract**— Many consumers have adopted the food of dietary supplements. However, since the threshold of professional knowledge for dietary supplements is usually high, most of the consumers do not possess sufficient knowledge for making an appropriate purchase decisions as they concern buying the products of dietary supplements. As a result, many consumers rely on word-of-mouth as they need to make purchase decisions on buying dietary supplements. It causes health risk to consumers since the word-of-mouth may be wrong and thus to make consumers take wrong dietary supplements. To address this deficiency, this study explores how consumers' knowledge for dietary supplements and risk perceptions influence their search behavior for word-of-mouth in the purchase of dietary supplements. With a two-stage cluster sampling strategy, 370 questionnaires were distributed to the customers of retail stores for selling Ganoderma dietary supplements, while 314 questionnaires were valid for statistical analysis. With the analysis of linear structural equation modeling, the causal structural relation among consumers' product knowledge, risk perception and word-of-mouth search behavior was examined. According to the statistical results, consumers' subjective product knowledge has greater overall impacts on the degree of word-of-mouth search behavior, compared with consumers' objective product knowledge. Namely, if consumers have more subjective knowledge for products, they are less likely to rely on word-of-mouth for the purchase of dietary supplements. For promoting the concept of food safety to consumers, consumers should be prepared with more correct product knowledge, in order to develop trust in self product knowledge in the publicity of safe consumption of dietary supplements, and reduce their dependence on the reputation of the dietary supplements

without clear sources.

**Keywords**— word-of-mouth, product knowledge, information search, risk perception, food safety.

## I. INTRODUCTION

Due to the emergence of health-oriented lifestyle, dietary supplements have become a major line of product in the food biotechnology industry. According to the statistics, the transaction value of the global dietary supplement market reached USD 195.8 billion in 2011 (Liu, 2012), and the scale of dietary supplement market in Taiwan was NT\$ 62.5 billion, accounting for 10.4% of the entire food consumption market and becoming the largest food industry in Taiwan (Chen, 2008; Chen, 2007). In fact, many consumers have accepted the idea of using dietary supplements to strengthen bodily functions. According to the consumer survey by the International Food Information Council Foundation, over 70% of the interviewed people agree that consuming particular food could enhance bodily functions and ensure health (Liu, 2007). Nevertheless, dietary supplements often involve complicated constituents and effective ingredients, physiological mechanism or manufacturing procedure. Therefore, the threshold of product knowledge for dietary supplements is high. According to the theory of consumers' purchase decision process, consumers with inadequate internal knowledge would seek more external information so as to reduce purchase risk in highly risky purchases. Consumers can obtain information through diverse channels, among which word-of-mouth (WOM) is nearly the most reliable external information source for consumers. Hence, WOM is often regarded as the main external information for consumers (Bansal & Voyer, 2000; Mattila & Wirtz, 2002). According to the results of Nielsen's online questionnaire survey on 47 countries in

2007, WOM is the most trustworthy information source for purchase decision (Nielsen, 2007). The consumer studies on dietary supplements in recent years have also shown that dietary supplements are consumer goods with high risk perception and high involvement of information search, while WOM play an important role as reference to the consumers for purchasing dietary supplements (Pillai & Hofacker, 2007; Raju et al., 1995; Slone, 2006).

From the perspective of foods and drugs safety, consumers' excessive dependence on WOM may lead to much anxiety in the safety of food and drug consumption. Despite that health foods must pass the entire review and testing procedure of the government before it is launched in the market, consumers often misuse dietary supplements or trust the WOM without clear sources due to the lack of adequate professional knowledge, thus suffer from physical and mental harms (Hsieh, 2008). Moreover, some manufacturers purposely adopt buzz marketing to avoid the regulation on prohibiting the publicity with medical effects. In buzz marketing, bloggers, shopping experts and experienced users share their experiences to attract consumers. The Ministry of Health and Welfare implemented the "Five DO NOTs in Safe Medicine Consumption," namely "Do not trust," "Do not listen," "Do not buy," "Do not take" and "Do not recommend" to warn consumers on mistrust of inappropriate advertisement or WOM on dietary supplements. However, as the threshold of the professionalism on these products is high, many consumers still make purchase decisions based on the commercial advertisement of manufacturers or WOM of friends and family (Shih et al., 2010; Ministry of Health and Welfare, 2010).

As discussed above, studies on consumers' WOM search behavior are valuable to the publicity of foods and drugs safety. However, most of previous studies on the consumption of dietary supplements focused on consumers' acceptance (Frewer et al., 2003; Siró et al., 2008), attitude and understanding of dietary supplements (Childs & Poryzees, 1997; Verbeke, 2005), as well as use evaluation and purchase choice (Hailu et al., 2009; Teratanavat & Hooker, 2006; Urala & Lähteenmäki, 2003; Wandel & Bugge, 1997; West et al., 2002), while seldom on consumers' WOM search behaviors. Therefore, this study attempts to make up for this deficiency. The purposes of this study are as follows: (1) to explore the effects of consumers' product knowledge on their WOM search behavior on dietary supplements; (2) to analyze the mediating role of risk perception on consumers' product knowledge and WOM search behavior in their purchase of dietary supplements.

## II. LITERATURE REVIEW

### 1. Product knowledge

Product knowledge refers to the degree to which a person knows about a certain product (Beatty & Smith, 1987; Solomon, 2007). It can be divided into three types according to the knowledge content: (1) Subjective knowledge: referring to consumers' measurement of their product knowledge, or their subjective understanding or self-evaluation of their product knowledge, implying the confidence that consumers show in their product knowledge; (2) Objective knowledge: referring to the amount, type and structure of information a person stores in his/her long-term memory or the degree to which a consumer knows a product in reality; (3) Experience-based knowledge: referring to the product experience that a person gradually accumulates through the purchase or use of a product as his/her product knowledge (Brucks, 1985; Park et al., 1994). As the processing of the product information differs from person to person and is difficult to measure, scholars often took objective and subjective product knowledge as the benchmark of the measurement of consumers' product knowledge (Brucks, 1985; Mattila & Wirtz, 2002; Park et al., 1994). In the purchase decision process, consumers' product knowledge plays an important role in consumers' information search and processing (Pillai & Hofacker, 2007; Raju et al., 1995).

### 2. Perceived risk

Perceived risk refers to psychological uncertainty. Bauer (1967) defined perceived risk as the uncertainty and negative results that consumers have to face when they cannot predict the results of purchase decision. For instance, the dietary supplement companies tend to label the effective ingredients of their products and emphasize on the health-enhancement effects, so as to intrigue consumers' purchase intention. However, as consumers do not have adequate professionalism on dietary supplements, they may not fully understand or be able to evaluate the reliability of the product information provided by the manufacturers. As a result, they become uncertain about the health-enhancement effects of dietary supplements and develop perceived risk (Solomon, 2007).

Previous studies have suggested that consumers' perceived risk has a multi-dimensional structure. Adopting the concept of time risk proposed by previous researchers suggested that consumers need to spend time and energy in the purchase decision-making, and thus face the risk of uncertainty in time and energy (Peter & Tarpey, 1975; Roselius, 1971). Jacoby and Kaplan (1972) indicated that consumers' perceived risk consists of six dimensions, namely, financial risk, psychological risk, efficacy risk, health risk, social risk, and time risk. These six risk dimensions have been cited in numerous studies as the basis for measuring consumers' perceived

risk (Brooker, 1984). Dietary supplements are classified as food products, but as they can enhance health and need sophisticated processing technologies to ensure the functions, they are often sold at a high price. Moreover, if they are consumed in an inappropriate way, consumers may not obtain desired health-enhancement effects, or even suffer from physical health problems, in worse cases. Hence, a wrong decision on the purchase of dietary supplements would cause financial risk, efficacy risk, and health risk to consumers. The threshold of the product knowledge on dietary supplements is high and the product functions are specialized, so the purchase decision of dietary supplements requires high involvement, and may lead to high time risk. Additionally, the doubt over the functions and possible side effects of dietary supplements would also result in the psychological pressure on consumption. Consumers may face social risks due to disagreement from their friends and family.

### 3. Correlation among product knowledge, risk perception and WOM search

Bansal and Voyer(2000) conducted experiments on the purchase decisions of consumers in the service industry. The research results showed that consumers' subjective product knowledge was in a significant negative correlation with perceived risk. In other words, if consumers have more subjective product knowledge, they will feel less perceived risk. Klerck and Sweeney(2007) explored the effects of consumers' subjective and objective product knowledge on their perceived risk of genetically-modified food in Australia. According to the research results, consumers' objective product knowledge has a significant negative correlation with the functional risk and psychological risk of products. As consumers gain more objective product knowledge, their perceived risk is reduced significantly. Lusk and Rozan(2005) found that if the consumers in the U.S. and Europe have less objective product knowledge on genetically-modified food, they would have greater perceived risk of the food and then have a weaker intention of purchasing it. Nevertheless, different product knowledge has different impacts on the risk perception of biological products. Sufficient objective product knowledge helps to alleviate consumers' efficacy risk perception and psychological risk perception of genetically-modified food, while sufficient subjective product knowledge increases their health risk perception of the food. However, it only happens when consumers have little objective knowledge on the food (Klerck& Sweeney, 2007). House et al.(2004) found that the type of product knowledge would influence consumers' acceptance of genetically-modified products. For them, sufficient subjective product knowledge would enhance consumers' acceptance of the products, while objective product knowledge has little impact on

consumers' acceptance of the products. Previous studies on the consumption of dietary supplements seldom analyzed the correlation between product knowledge and risk perception, but the research results showed that well-educated consumers are more likely to use dietary supplements than those with lower educational level, who also seldom have positive use experience and have doubts about the consumption of dietary supplements (Landström et al, 2007; Niva&Mäkelä, 2007). According to the above literature review, this study proposes the following hypotheses:

**H1 a:**When consumers have more subjective product knowledge on dietary supplements, they have less perceived risk of purchase.

**H1 b:**When consumers have more objective product knowledge on dietary supplements, they have less perceived risk of purchase.

Consumers that lack product knowledge have highly complicated risk perception. If they are involved in the consumption with high perceived risk, they tend to search information to reduce the probability of risk; when they perceive higher risks, they would collect more information (Solomon, 2007). In the process of information search, consumers often face a problem -- the reliability of information sources. To lessen the risk of wrong information, consumers tend to acquire information from the most reliable information source(Goyal, 2008; Solomon, 2007). Among the information source, the most reliable one is the WOM from consumers' interpersonal network, which is often the important reference information that the consumers use to analyze risk and reduce their perceived risk (Beatty & Smith, 1987; Hirunyawipada&Paswan, 2006). According to the results of foreign studies, as consumers have high perceived risk on dietary supplements, they tend to show high involvement in information search, in particular, WOM provides reference for consumers (Pillai &Hofacker, 2007; Raju et al., 1995; Slone, 2006). Studies in Taiwan found that Taiwanese consumers without adequate professional knowledge would purchase dietary supplements according to commercial advertisements or WOM from friends and/or family (Hsieh, 2008; Ministry of Health and Welfare, 2010; Shih, 2010). Based on the literature review, this study proposes the following hypothesis:

**H2:**When consumers have higher perceived risk on dietary supplements, they are more likely to search for information for the purchase of dietary supplements.

To date, no conclusion has been drawn on the impacts of consumers' product knowledge on their information search. Although previous studies have reached varied results, they could be categorized into three groups: (1) consumers' product knowledge has significant positive effect on their information search; (2) consumers' product knowledge has significant negative effect on their information search; (3) consumers' product knowledge is in a U-shaped relationship with their information search (Wang, 1999; Fiske, 1994).

Raju et al. (1995) argued that consumers' product knowledge influences their dependence on and preference for different types of information and their ability to process information in the purchase decision (Raju et al., 1995). In general, consumers with sufficient product knowledge have better information search skills and can use more appropriate clues to facilitate purchase decision-making. Moreover, they tend to evaluate their decisions according to the possible positive or negative results caused by the purchase and seldom make decisions according to actual clues (Raju et al., 1995; Cordell, 1997). Park and Lessig found that consumers with little product knowledge tend to rely on non-functional clues (e.g., price and brand) in their purchase decisions; they spend more time on decision-making than those with much product knowledge and are less confident in their decisions (Park & Lessig, 1981). Bettman and Park found that consumers with average knowledge have diverse methods to process available information and seldom rely on existing knowledge or experience. It is deduced that consumers with little product knowledge may not be able to process information due to their inadequate knowledge level, thus lack the motivation to analyze or process existing information. Consumers with sufficient product knowledge are capable to process information. As there is abundant internal information and rich experience in the use of products, they also lack the motivation to process existing information and tend to rely on their internal information and relevant experience (Bettman & Park, 1980). The research results also reveal that the consumers with much product knowledge feature great involvement in brand information while those with little product knowledge show more involvement in the attribute information of products than brand information.

The reference attributes that consumers rely on in the purchase decision of dietary supplements are diverse, including health benefit, efficacy, taste, sense, convenience, price and the familiarity with products, manufactures or brands. All these are essential reference factors that influence consumers' purchase decision (Urala & Lähteenmäki, 2003). Both functional and non-functional attributes of products are important clues for consumers in the purchase decision. According to the

above literature review, the amount of knowledge on dietary supplements influences consumers' ability to process these reference clues and their dependence on these clues, and then affect the degree of WOM search. Hence, this study proposes the following hypotheses:

**H3a:** Consumers' subjective product knowledge on dietary supplements has significant effects on their WOM search for making purchase decision on dietary supplements.

**H3b:** Consumers' objective product knowledge on dietary supplements has significant effects on their WOM search for making purchase decision on dietary supplements.

Perceived risk may play a mediating role between product knowledge and the degree of information search. In the construction of the theoretical model of risk response strategies for consumers, Dowling and Staelin suggested that consumers' prior knowledge is one of the antecedents that triggers their perceived risk and then influences the following-up information search (Dowling & Staelin, 1994). After that, some studies demonstrated the mediating role of perceived risk between product knowledge and information search in relevant empirical studies. For example, Klerck and Sweeney (2007) took genetically-modified food for a case study to explore consumers' product knowledge, perceived risk and information search. They found that consumers' product knowledge influences their efficacy risk and psychological risk perception of genetically-modified food, and then affects their tendency of information search before the purchase. In other words, the consumers with less product knowledge would have stronger risk perception and tendency to seek more relevant information. Scholars also found similar results in the studies on consumers' purchase of wine. Consumers' inadequate knowledge on wine would increase their risk perception of purchase, so they would seek external information to reduce possible purchase risks (Olsen et al., 2003). Atkin and Thach (2012) delved into the risk perception and information search of wine purchase of the millennium generation and found that the millennium generation often sought external information to reduce their perceived risk if they did not have adequate product knowledge. Among the relevant external information, WOM is regarded as highly reliable among consumers. Previous studies on the correlation between product knowledge and information search seldom discussed the mediating role of perceived risk. This may explain the reason why there is such great difference in the results of the studies on the correlation between consumers' product knowledge and information



search(Fiske et al., 1994; Wang, 1999).

knowledge and WOM search.

According to the above research hypotheses, the research structure of this study is shown in Fig.1.

#### H4: Consumers' perceived risk of dietary supplements plays an mediating role between their product

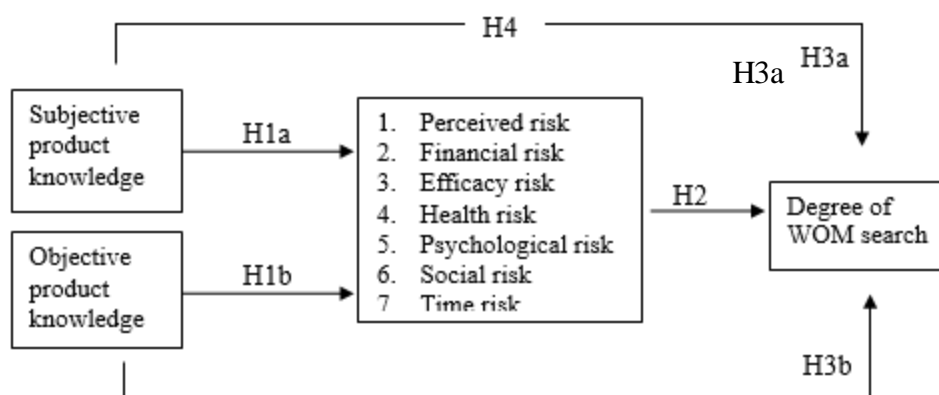


Fig.1: The conceptual work of the study

### III. MATERIALS AND METHODS

#### 1. Materials

Ganoderma is a traditional Chinese herb for health enhancement, and is highly popular in the market. The annual growth rate of the market demand for Chinese herbs with health enhancement effects is about 4.4%, and the transaction volume was predicted to reach USD 1.3 billion by 2015 (Liu, 2008). With great market potential, Chinese herbs are listed as major technological development by the government of Taiwan (Chen, 2009). This study took ganoderma for a case study, and a questionnaire survey was conducted to validate the theoretical model constructed in this study.

#### 2. The operational definition of variables and the design of measurement items

In this study, the questionnaire was used to collect data. The official questionnaire consists of five parts. Part 1 comprises 18 items and measures consumers' perceived risks in the purchase of ganoderma dietary supplements. Part 2 includes 8 items and measures consumers' WOM search on ganoderma dietary supplements. Part 3 has 5 items and measures consumers' subjective product knowledge on ganoderma dietary supplements. Part 4 consists of 6 items and measures consumers' objective product knowledge on ganoderma dietary supplements. Part 5 includes 5 items and records the social and economic background information of the respondents. After the questionnaire was developed, 30 copies were distributed for a pre-test to ensure that the meaning of the items was conveyed accurately and appropriately. The operational definition of the variables and the design of the measurement items are as follows:

#### (1) Product knowledge

The measurement items for the variable "subjective product knowledge" are developed based on scholars' definition for the variable (Brucks, 1985; Park et al., 1994), so they have the content validity. In this study, five items were developed to test consumers' subjective product knowledge on ganoderma dietary supplements. Additionally, this study defined consumers' objective knowledge on ganoderma dietary supplements as the amount, type and structure of the information consumers store in their long-term memory or as consumers' actual knowledge on ganoderma dietary supplements. Relevant measurement items were made according to the operation in previous studies (Mattila & Wirtz, 2002; Park et al., 1994; Raju et al., 1995). After the information about ganoderma dietary supplements was collected and the items were developed (Ganoderma Health Foundation of Legal Persons of Consortium, 2009), three experts who specialized in the physiological development of ganoderma and the processing of ganoderma food were invited to test the validity of the measurement items. In other words, the expert validity method was used to ensure that the items were objective, definite and distinguishable, so as to test consumers' actual objective knowledge on ganoderma dietary supplements.

#### (2) Perceived risk

According to scholars' definition of perceived risk, this study defined perceived risk as the anxiety that consumers feel when they are unsure if the dietary supplements they purchase would meet their expectation. The perceived risk is divided into financial risk, efficacy risk, health risk, psychological risk, social risk and time

risk (Bauer, 1967; Stone & Gronhaug, 1993). The content validity method was also adopted to develop the questionnaire. Apart from the items of the above six risk dimensions proposed by Stone and Gronhaug (1993), this study considered other scholars' opinions on perceived risk (Brooker, 1984; Jacoby & Kaplan, 1972; Peter & Tarpey, 1975; Roselius, 1971) and adopted the items that scholars used to test consumers' perceived risk of different products (Klerck & Sweeney, 2007; Stone & Gronhaug, 1993). According to the comparison of consumers' features in the consumption of dietary supplements, the items were developed to test consumers' perceived risk of ganoderma dietary supplements.

### (3) WOM search

In this study, the degree of WOM search is defined as the degree to which consumers collect others' opinions, use experience or comments in their purchase decisions of dietary supplements. The measurement items was developed based on the ones adopted by previous scholars regarding the measurement of consumers' volunteer inquiry of WOM (Bansal & Voyer, 2000; Bertrandias & Goldsmith, 2006). Based on the literature review, this study designed eight items to measure the degree to which consumers search WOM search for purchase decision of ganoderma dietary supplements. Since these measurement items were based on previous definitions and scales, thus they have good content validity.

### 3. Sampling

The subjects of this study were existing and potential consumers of ganoderma in Taipei City. Two-stage cluster sampling was adopted to develop the structural equation model for analyzing and controlling the error of the analytical results under the condition that the normalized hypothesis is valid. First, the 12 administrative regions of Taipei City were numbered from "1" to "12", and random sampling was adopted to select four administrative regions. After that, all the neighborhoods in four administrative regions were numbered, and four neighborhoods were randomly selected from each administrative region. To ensure that the selected samples were existing and potential consumers of ganoderma, samples were collected from the marketing channels of ganoderma dietary supplements. The marketing channels included Chinese and Western pharmacies and chain drug stores (Chou, 2005; Hair et al., 2006).

### 4. Statistical Analyses

#### (1) Reliability and validity tests

Reliability coefficient of scales refers to the reliability of the items of a variable or the consistency or stability of the results of measurements; the validity of scales indicates the effectiveness of scales or the degree to which the adopted scales can measure the targeted

subjects (Hair et al., 2006). The reliability of the measurement items of this study was analyzed with Cronbach's  $\alpha$ . Aside from the above content validity method and the expert validity method, the maximum likelihood estimation of the confirmatory factor analysis was used to estimate parameters and calculate the composite reliability and average variance extracted (AVE) of the measurement items, and test the convergent validity and discriminant validity of the measurement items.

According to previous studies, four evaluation norms were compiled by this study to test the convergence of the items (Bagozzi & Yi, 1989; Hair et al., 2006): (1) the goodness of fit index (GFI), the normed fit index (NFI) and the comparative fit index (CFI) must be higher than 0.9, while the root mean square residual (RMR) must be lower than 0.05; (2) the factor loads of the items were significant ( $\alpha = 0.05$ ); (3) the composite reliability (CR) of the items of the variables must be higher than 0.7; (4) the average variance extracted (AVE) must be higher than 0.5.

Discriminant validity refers to the relevance between the items describing a variable in the measurement tool and that describing other items. It is also called divergent validity. If the relevance between two variables is weak, it means that the measurement items between the two variables have discriminant validity. This study adopted the discriminant validity evaluation proposed by Fornell and Larcker (1981) to test the AVE of the items of each variable.

#### (2) Analysis of the theoretical model

This study employed the structural equation modeling (SEM) to validate the causal relationship among consumers' product knowledge, perceived risk and the degree of WOM search for the purchase decision of dietary supplements. According to the two-stage analysis and previous studies, this study first conducted the confirmatory factor analysis to test the goodness of fit of the model. Then, the operational SEM was analyzed to discuss the causal relationship among the potential variables (Anderson & Gerbing, 1988; McDonald & Ho, 2002). The above methods were based on the prerequisite that the observation variables are in a normal distribution. Hence, the skewness and kurtosis of the observation variables were used to test the normality of the data before the confirmatory factor analysis and the SEM analysis.

## IV. RESULTS

### 1. Structural features of samples

This study distributed 370 copies of questionnaire, and retrieved 314 valid samples, including 128 from males (40.8%) and 186 from females (59.2%). In terms of age, most of the respondents aged from 35 to 44 (32.5%),

followed by 25 to 34 (30.6%), and lastly 18 to 24. As for occupation, most of them work in the business/service industry (37.6%), followed by military, civil servants, and teachers (22.3%), and lastly the retirees. In terms of educational background, most of them have university or college education (68.8%). Regarding monthly disposable

income of household, most of them have a monthly disposable income of NT\$ 70,001 to NT\$ 90,000, followed by NT\$50,001 to NT\$ 70,000, and lastly NT\$ 150,001. The social and economic background structure of the respondents is shown in Table 1.

Table.1: The socio-economics of the samples

Variable	Population	Percentage (%)	Variable	Population	Percentage (%)
<b>Gender</b>			<b>Jobs</b>		
Male	128	40.8	Staff of agriculture, forestry, fishery and husbandry	22	7.0
Female	186	59.2	Mining/manufacturing	28	8.9
<b>Age</b>			Business/service industry	118	37.6
18-24 years old	16	5.1	Soldier/civil servant/teacher/policeman	70	22.3
25- 34 years old	96	30.6	Student	16	5.1
35-44 years old	102	32.5	Housekeeper	24	7.6
45-54 years old	64	20.4	Retirement	4	1.3
55-64 years old	36	11.5	Others	32	10.2
<b>Education</b>			<b>Monthly disposable income of household</b>		
Primary school or below	2	0.6	NT\$30,000 or below	8	2.5
Secondary school	2	0.6	NT\$30,001 ~ \$50,000	62	19.7
High school/vocational school	32	10.2	NT\$50,001 ~ \$70,000	88	28.0
University/junior college	216	68.8	NT\$70,001 ~ \$90,000	96	30.6
Research institute or above	62	19.7	NT\$90,001 ~ \$120,000	48	15.3
			NT\$120,001 ~ \$150,000	10	3.2
			NT\$150,001 or above	2	0.6

## 2. Results of the reliability and validity tests

The Cronbach's  $\alpha$  of "subjective product knowledge" was 0.94, and those for "financial risk perception", "Efficacy risk perception", "Health risk perception", "Psychological risk perception", "Social risk perception" and "Time risk perception" were 0.83, 0.89, 0.91, 0.88, 0.82 and 0.85, respectively. The Cronbach's  $\alpha$  of "Degree of WOM search" was 0.86. Additionally, the measurement items of "objective product knowledge" were made to test consumers' actual knowledge on ganoderma dietary supplements (Mattila & Wirtz, 2002; Park et al., 1994; Raju et al., 1995; Ganoderma Health Foundation of Legal Persons of Consortium, 2009). According to the definition of objective product knowledge and the operation in previous studies, this

study measured consumers' basic knowledge on ganoderma dietary supplements. A higher score indicates more objective product knowledge on ganoderma dietary supplements. The test items covered the source of the bitterness of ganoderma, the effective ingredients of ganoderma, the making of ganoderma products, and the immune effects of ganoderma. For that reason, the reliability of the items about objective product knowledge differed from that of the items based on the Likert's 5-point scale and thus cannot be represented through Cronbach's  $\alpha$ . Therefore, this study adopted the expert review method, where three experts who specialize in the physiological development of ganoderma and the processing of ganoderma food were invited to test the validity of the items.

As for the validity test on the items, the items were compiled according to the content validity and the expert review method in the process, and the maximum likelihood estimation of the confirmatory factor analysis was also used to calculate the composite reliability and AVE of the items of the variables and test the convergent validity and discriminant validity of the items. The results of relevant tests are shown in the following test on goodness of fit of the measurement model.

### 3. Validation of the theoretical model

#### (1) Normal distribution of data

In this study, the statistical skewness and kurtosis were used to test the normal distribution of data. In the operation of the SEM, if the absolute value of the skewness of the data concerning variables is less than 3 and the kurtosis is less than 10, it would be regarded as normal distribution (Kline, 2011). In this study, the normal distribution of the variables is shown in Tables 2 to 4. The absolute values of the skewness and kurtosis of the variables are in the scope of evaluation values, showing that the data concerning the variables of this study met the statistical hypothetical conditions of normal distribution and were suitable for the confirmatory factor

analysis and the SEM analysis.

#### (2) The goodness of fit of the measurement model

In this study, the maximum likelihood estimation of the confirmatory factor analysis was adopted to test the goodness of fit of the measurement models. The adopted indexes include: (a) the factor loads of the items were significant ( $\alpha=0.05$ ); (b) the measured value of composite reliability was higher than 0.7; (c) the measured value of AVE was higher than 0.5; (d) the GFI, NFI and CFI must be higher than 0.9, and the RMR must be lower than 0.05. The results are as follows:

- 1) The measurement model of subjective product knowledge: (a) the factor loadings of the items were all significant ( $P < 0.001$ ); (b) the composite reliability was 0.941, meeting the criterion of higher than 0.7; (c) the AVE was 0.764, also meeting the criterion of higher than 0.5; (d) the GFI, NFI and CFI were 0.967, 0.982 and 0.985 respectively, all higher than 0.9, while RMR was 0.017, lower than the criterion of 0.05. The test results revealed that the measurement model of subjective product knowledge has effective goodness of fit (Table 2).

Table.2: Confirmatory factor analysis and normal distribution test of the measurement model of subjective product knowledge

Variable	Estimated Parameter of MLE				Normal Distribution Test	
	Factor Load ( $\lambda$ )	Measurement Error ( $\delta$ )	CR	AVE	Skewness	Kurtosis
Subjective product knowledge	--	--	0.941	0.764	0.573	-0.075
1. I believe that I have sufficient knowledge on ganoderma.	0.742*	0.449	--	--	0.323	-0.333
2. It is safe to say that I am an expert on ganoderma in my social network.	0.887*	0.213	--	--	1.234	1.751
3. I have more knowledge on ganoderma than most people do.	0.928*	0.139	--	--	0.786	0.305
4. I have a good command of the knowledge on ganoderma.	0.905*	0.181	--	--	0.591	0.172
5. I am confident in selecting ganoderma products.	0.895*	0.199	--	--	0.602	-0.497

GFI=0.967, NFI=0.982, CFI=0.985, RMR=0.017

\*  $p < 0.001$

a: Composite Reliability

b: Average Variance Extracted

- 2) The measurement model of objective product knowledge: each item of the objective product knowledge of this study can directly indicate the amount of information of consumers. The total score

of the items was taken as the observation item and added into the model. The confirmatory factor analysis was not suitable for the measurement of this variable, so in the construction of this measurement



model, this study used literature review to ensure that the measurement indexes met the theoretical foundation. Moreover, the expert review method was employed to ensure the goodness of fit of this measurement model.

- 3) The measurement model of perceived risk: (a) the factor loadings of the items were all significant ( $P < 0.001$ ); (b) the composite reliability of the two-stage confirmatory factor analysis of perceived risk was

0.853, meeting the criterion of higher than 0.7; (c) the AVE was 0.509, meeting the criterion of higher than 0.5; (d) the GFI, NFI and CFI were 0.837, 0.865 and 0.890 respectively, higher than 0.8 (within the acceptable scope) though lower than the criterion of higher than 0.9. The RMR was 0.069. Although the RMR was lower than the criterion of lower than 0.05, it was also within the acceptable scope (Hair et al., 2006) (Table 3).

Table.3: Confirmatory factor analysis and normal distribution test of the measurement model of perceived risk

Variable	Estimated Parameter of MLE		Normal Distribution Test			
	Factor Load ( $\lambda_x$ )	Measurement Error ( $\delta$ )	CR	AVE	Skewness	Kurtosis
Perceived risk	--	--	0.853	0.509	0.488	0.788
<i>Financial risk</i>	0.860*	0.260	0.844	0.648	0.317	-0.470
1. I think it is a waste of money to buy ganoderma.	0.920*	0.154	--	--	0.447	-0.272
2. I think buying ganoderma would bring me financial burden.	0.628*	0.606	--	--	-0.125	-0.733
3. I do not think it worthy to buy ganoderma.	0.839*	0.296	--	--	0.379	-0.397
<i>Efficacy risk</i>	0.746*	0.443	0.893	0.736	-0.400	-0.105
1. I do not think ganoderma is effective.	0.894*	0.201	--	--	-0.446	-0.452
2. I am worried that ganoderma would not bring the expected effects.	0.884*	0.219	--	--	-0.596	-0.227
3. I have no confidence in the functions of ganoderma.	0.791*	0.374	--	--	0.097	-0.672
<i>Health risk</i>	0.774*	0.401	0.912	0.778	0.353	-0.647
1. I am worried that ganoderma would cause side effects.	0.917*	0.159	--	--	0.179	-0.717
2. I am worried that ganoderma would cause health problems.	0.979*	0.042	--	--	0.243	-0.729
3. I am worried that ganoderma may cause potential risk to my health.	0.732*	0.464	--	--	0.189	-0.930
<i>Psychological risk</i>	0.843*	0.289	0.890	0.730	1.067	1.709
1. I worry about the consumption of ganoderma.	0.813*	0.339	--	--	1.091	1.286
2. I feel anxious about the consumption of ganoderma.	0.919*	0.155	--	--	1.087	2.007
3. Consuming ganoderma would impose pressure on me.	0.828*	0.314	--	--	0.996	0.999
<i>Social risk</i>	0.589*	0.653	0.832	0.626	0.987	1.550
1. I am worried that it is against my social	0.702*	0.507	--	--	0.946	1.033

Table.3: Confirmatory factor analysis and normal distribution test of the measurement model of perceived risk

Variable	Estimated Parameter of MLE				Normal Distribution Test	
	Factor Load ( $\lambda$ x)	Measurement Error ( $\delta$ )	CR	AVE	Skewness	Kurtosis
status to consume ganoderma.						
2. I am worried that my friends would make joke of my consuming ganoderma.	0.913*	0.166	--	--	1.106	1.511
3. I am worried that my friends would disapprove of me on the consumption of ganoderma.	0.742*	0.449	--	--	0.780	0.444
<i>Time risk</i>	0.320*	0.898	0.867	0.695	-0.231	-0.816
1. I think it takes much time to collect the information about ganoderma.	0.566*	0.680	--	--	0.002	-0.781
2. I think it takes much time to search for information on choosing ganoderma products.	0.908*	0.176	--	--	-0.247	-0.723
3. I think it takes much time to search for information on how to use ganoderma products.	0.969*	0.061	--	--	-0.178	-0.708

GFI=0.837, NFI=0.865, CFI=0.890, RMR=0.069

\*  $p < 0.001$

a: Composite Reliability

b: Average Variance Extracted

- 4) The measurement model of the degree of WOM search: (a) the factor loadings of the items were all significant ( $P < 0.001$ ); (b) the composite reliability of the two-stage confirmatory factor analysis of perceived risk was 0.887, meeting the criterion of higher than 0.7; (c) the AVE was 0.525, meeting the criterion of higher than 0.5; (d) the GFI, NFI and CFI were 0.853, 0.842 and 0.844 respectively, higher than 0.8 (within the acceptable scope) though lower than the criterion of higher than 0.9. The RMR was

0.052. Although the RMR was lower than the criterion of lower than 0.05, it was also within the acceptable scope (Hair et al., 2006) (Table 4).

This study referred to the discriminant validity criterion suggested by Fornell and Larcker (1981) to test the AVE of the items of each variable. The results showed that the AVE of each variable was higher than the variable and the squared value of relevant coefficients of other variables. This means that the variables of this study have effective discriminant validity.

Table.4: Confirmatory factor analysis and normal distribution test of the measurement model of the degree of WOM search

Variable	Estimated Parameter of MLE				Normal Distribution Test	
	Factor Load ( $\lambda$ x)	Measurement Error ( $\delta$ )	CR	AVE	Skewness	Kurtosis
Degree of WOM search	--	--	0.887	0.525	-0.205	-0.291
Active search					-0.691	0.557
1. I would consider others' suggestions in the purchase of ganoderma.	0.850*	0.245	---	---	-0.457	0.141
2. I would consult others before	0.879*	0.235	---	---	-0.606	-0.104

purchasing ganoderma.						
3. Others' opinions would make me feel assured when I purchase ganoderma.	0.833*	0.377	---	---	-0.657	0.237
4. I would collect relevant negative comments before purchasing others' opinions.	0.567*	0.577	---	---	-0.837	0.820
5. I would collect relevant positive comments before purchasing others' opinions.	0.687*	0.408	---	---	-1.117	1.893
Passive search					---	---
I seldom ask others about how to purchase ganoderma.	0.829*	0.256	---	---	0.063	-0.936

GFI=0.853, NFI=0.842, CFI=0.844, RMR=0.052

\*  $p < 0.001$

a: Composite Reliability; b: Average Variance Extracted

### (3)The goodness of fit of theory model

Previous studies have proposed different suggestions on the test on the goodness of fit of the SEM. Following the suggestions from Bagozzi et al. and Hair et al. (Bagozzi & Yi, 1989; Hair et al., 2006), this study tested three types of goodness of fit, including the absolute fit measures, the incremental fit measures, and the parsimonious fit measures. The results are shown in Table 5. The meaning and index results of the measures are as follows:

- 1) Absolute fit measures: it tests the degree of fit between the overall model and actual data. The indexes adopted in this study were square degree of freedom ( $\chi^2/d.f.$ ), GFI, RMR and RMSEA. The suggested value of square degree of freedom was under 3, which indicates that the overall model and observation data have effective fit. The square degree of freedom ( $\chi^2/d.f.$ ) of the overall theoretical model was 2.978, meeting the suggested value. Goodness fit index (GFI) refers to the ratio (Hair et al., 2006) of the variance and co-variate that can be explained by the measurement theory model. If GFI is closer to 1, the overall fit is higher and the explanatory ability of the model is stronger. In general, a GFI higher than 0.9 is taken as the threshold value, and GFI should be higher than 0.8 (Bagozzi & Yi, 1989). The GFI of the overall theoretical model of this study was 0.868, which indicates that the fit of the proposed model is accepted. In terms of RMR, Hair et al. (2006) suggested that a smaller RMR is better and the best RMR is lower than 0.05. RMSEA is not influenced by either the number of samples or the complexity of model. In general, a lower RMSEA indicates a higher fit of model, and a RMSEA lower than 0.08 is regarded as the criterion (Hair et al., 2006). The

RMR of the model established in this study was 0.049, and the RMSEA was 0.076, meeting the suggestion that RMSEA be lower than 0.05 and 0.08.

- 2) Incremental fit measures: it is used to measure the difference between the hypothetical theoretical model and the null model. The indexes adopted in this study included AGFI, NFI and CFI. AGFI is obtained by adjusting the degree of freedom of fit index (Hair et al., 2006). If it is closer to 1, the overall fit is higher and the explanatory power of model is stronger. In general, a GFI higher than 0.9 is taken as the threshold value, and GFI should be higher than 0.8 (Bagozzi & Yi, 1989). The AGFI of the overall theoretical model of this study was 0.807, which indicates that the fit of the proposed model is accepted. NFI is used to reflect the incremental fit of model, and a NFI higher than 0.9 is regarded as the criterion (Hair et al., 2006). According to the statistical results, the NFI of the hypothetical model constructed in this study was 0.914, meeting the suggestion that NFI be higher than 0.9. CFI is used to show the difference between the theoretical model and the independent model without any co-variate relation. A suggested CFI is higher than 0.9. In this study, the CFI of the proposed was 0.943, meeting the suggestion that measured CFI be higher than 0.9.
- 3) Parsimonious fit measures: it is used to compare the fit of the estimate coefficients of the models with different number of estimate coefficients. The adopted indexes were PNFI and PCFI. Both PNFI and PCFI should be higher than 0.5 to reach a good fit (Hair et al., 2006). The PNFI and PCFI of the proposed theoretical model were 0.616 and 0.637 respectively, both of which were higher than 0.5 and within the scope of suggested values.

Table.5: Results of test on the fit of theoretical model

Fitness test	Evaluation index	Criterion	Results of analysis	Evaluation of Fitness test
Absolute fit measures	$\chi^2/\text{d.f.}$	<3	2.978	Effective
	GFI	>0.9 (or >0.8)	0.868	Acceptable
	RMR	<0.05	0.049	Effective
	RMSEA	<0.08	0.076	Effective
Incremental fit measures	AGFI	>0.9 (or >0.8)	0.807	Acceptable
	NFI	>0.9	0.914	Effective
	CFI	>0.9	0.943	Effective
Parsimonious fit measures	PNFI	>0.5	0.616	Effective
	PCFI	>0.5	0.637	Effective

#### (4) Structural model of the correlation among product knowledge, perceived risk and the WOM search

The statistical results of the indexes measuring the fit of the causal relationship model of the variables of subjective product knowledge, objective product knowledge, perceived risk and the degree of WOM search was effective enough to explain the actual data. Therefore,

this study adopted the structural model obtained from the SEM analysis to test the path coefficients of potential variables to determine the statistical significance of the structural relation and the causal relationship among the variables. The results are shown in Table 6, and the path analysis of the causal relation among the potential variables is shown in Figure 2.

Table.6: Results of test on the path coefficients of the structural model

Paths	Path coefficient	<i>t</i>	<i>p</i>	Research hypothesis	Test results
Subjective product knowledge → Perceived risk	-0.42	-6.64	0.000***	H1a	Valid
Objective product knowledge → Perceived risk	-0.01	-0.39	0.694	H1b	Invalid
Perceived risk → Degree of WOM search	0.11	2.25	0.025**	H2	Valid
Subjective product knowledge → Degree of WOM search	-0.39	-5.98	0.000***	H3a	Valid
Objective product knowledge → Degree of WOM search	-0.23	-2.47	0.014**	H3b	Valid
Subjective product knowledge → Perceived risk → Degree of WOM search	---	---	---	H4a	Partially valid
Objective product knowledge → Perceived risk → Degree of WOM search	---	---	---	H4b	Invalid

\*\*  $p < 0.05$ ; \*\*\*  $p < 0.001$

The path analysis of the linear structural equation found that, the type of product knowledge has different impacts on consumers' perceived risk in their purchase of dietary supplements. Despite that consumers is in a positive correlation with their subjective and objective product knowledge of dietary supplements ( $\beta = 0.22$ ,  $P = 0.000$ ), the two factors have different impacts on the perceived risk of dietary supplements. Consumers' subjective product knowledge is in a negative causal relationship with their perceived risk, and the standardized path coefficient was -0.42 ( $P < 0.001$ ); hence,

H1a is supported. Consumers' objective product knowledge, however, does not have significant influence on their perceived risk ( $P = 0.694$ ); hence, H1b is not supported. The findings are consistent with previous studies, which indicated that consumers with more subjective product knowledge have less perceived risk of products (Bansal & Voyer, 2000; Srinivasan & Ratchford, 1991). Consumers' subjective product knowledge is correlated to objective product knowledge, the two have different impacts on consumer behaviors (Park et al., 1994; Raju et al., 1995; Teratanavat & Hooker, 2006).

The findings of this study suggest that consumers' perceived risk of dietary supplements has significant positive impacts on the degree of WOM search in their purchase decision of dietary supplements. The standardized path coefficient was 0.11. Although the influence weight is not high, it has statistical significance ( $P = 0.025$ ); hence, H2 is supported. This finding suggests that if consumers have more perceived risk of dietary supplements, the degree of WOM search is higher. This result is also consistent with previous studies (Goldsmith & Horowitz, 2006; Hennig-Thurau & Walsh, 2003).

According to the SEM in this study, consumers' subjective product knowledge has significant negative impacts on the degree of their WOM search, and the standardized path coefficient is  $-0.39$  ( $P < 0.001$ ); hence, H3a is supported. According to the analytical results, if consumers have more confidence in their knowledge of dietary supplements (or more subjective product knowledge), they are less dependent on WOM in the purchase decision of relevant products. Consumers' objective product knowledge also has similar impacts on the degree of WOM search in their purchase decision of dietary supplements. In other words, consumers' objective product knowledge has significant negative effects on the degree of WOM search, and the standardized path coefficient is  $-0.23$  ( $P < 0.05$ ); hence, H3b is supported. The results of this study are consistent with the theory on consumers' use of information. In other words, only in face of inadequate information would consumers voluntarily search for information and make greater efforts to obtain information to facilitate their consumption decision-making. According to the comparison of path coefficients, the direct impacts of subjective product knowledge are greater than that of objective product knowledge.

The analysis on the mediating role of perceived risk found that the indirect impacts of subjective product knowledge on the degree of WOM search are less than the direct impacts. The analysis of path coefficients found that the indirect impacts of subjective product knowledge on the degree of WOM search is  $-0.046$ , which is lower than the direct impacts ( $-0.390$ ). This result is not consistent with the criterion on a complete mediating relationship that the indirect impacts of an independent variable on a dependent variable must be greater than the direct impacts (Baron & Kenny, 1986). As the direct impacts of perceived risk on the degree of WOM search exist (or H2 is valid), the perceived risk still plays a mediating role in the relationship between subjective product knowledge and the degree of WOM search, though the indirect impacts of the intermediate role are weaker than the direct impacts. In the test on the mediating role of objective product knowledge, the

impacts of consumers' objective product knowledge on consumers' perceived risk are insignificant ( $P = 0.694$ ). This is inconsistent with previous studies that an independent variable must have significant impacts on a mediating variable (Baron & Kenny, 1986). Therefore, it can be deduced that the mediating role of perceived risk in the relationship between objective product knowledge and the degree of WOM search is invalid. Based on the above, H4 is partially supported.

## V. DISCUSSION

Due to the prevalence of chronic diseases and the problems associated with aging population, there has been an increasing demand for dietary supplements in Taiwan. With substantial market potential, dietary supplement has become a focus in Taiwan to promote the biotechnological industry. Although dietary supplements have to undergo rigorous inspection before launched into the market, they can be easily accessed and consumers can obtain them through general retailing channels without prescription. As a result, people tend to purchase dietary supplements based on their own judgment, and seldom seek for professional consultation. As the threshold on the product knowledge of agricultural and biotechnological dietary supplements is high, people without adequate knowledge would easily purchase dietary supplements according to WOM or the publicity manipulated by the manufacturers. Sometimes, consumers may mistakenly take some dietary supplements that are not legally licensed or contain prohibited ingredients, thus suffering physical problems. Despite that inappropriate WOM is a key factor that affects the drug safety, this study found that previous studies on the consumption of dietary supplements mostly focused on consumers' attitude, preference, evaluation and selection of dietary supplements, while seldom on consumers' WOM search. Therefore, this study explored the correlation between consumers' product knowledge of dietary supplements and the degree of WOM search.

This study carry both theoretical and practical contributions. The theoretical significance of this study is as follows. First, previous studies on other product fields showed that both subjective and objective product knowledge have a negative causal relationship with consumers' perceived risk. In other words, if consumers have more subjective or objective product knowledge, they have less perceived risk. This study took dietary supplements for the case study but found that there is a negative causal relationship between consumers' subjective product knowledge and perceived risk, and that the impacts of objective product knowledge on perceived risk are insignificant. Therefore, it is deduced that the impacts of consumers' product knowledge on perceived



risk differ according to the meaning of knowledge (e.g., subjective and objective product knowledge) and the product. Second, there are three arguments on the relevance between consumers' product knowledge and information retrieval, including positive correlation, negative correlation and U-shaped correlation. Taking dietary supplements for a case study, this study found that the two are in a negative correlation and that if consumers have more subjective and objective product knowledge, they have a lower degree of WOM search. Third, the correlation between consumers' product knowledge and information search differs according to knowledge. Subjective product knowledge has direct negative impacts on the degree of WOM search, and has indirect impacts with risk perception playing a mediating role. Through the negative impacts on risk perception, subjective product knowledge can indirectly lower the degree of WOM search. However, objective product knowledge merely has direct influence on the degree of WOM search, and risk perception does not play a mediating role in the relationship between the two.

In terms of practical contribution, the findings suggest that different dimensions of product knowledge have different impacts on consumers' dependence on WOM in the purchase decision of dietary supplements and the influence mechanisms are also different. Consumers' objective or subjective knowledge has direct negative influences on the degree of WOM search. In other words, if consumers have more objective or subjective knowledge, they have a lower degree of WOM search. Aside from imposing direct impacts on WOM search, consumers' subjective product knowledge also

influences the degree of WOM search through risk perception as a mediating role. If consumers have more subjective product knowledge, they have less risk perception of the dietary supplements and thus show a lower degree of WOM search. However, the impacts of objective product knowledge on risk perception are insignificant, risk perception does not have mediating effect on the relationship between objective product knowledge and the degree of WOM search. Obviously, consumers' risk perception in the purchase decision of dietary supplements comes from their inadequate confidence in their product knowledge. Therefore, they consider WOM and others' use experience to reduce possible purchase risk. Hence, the institutions in charge of drugs safety should offer correct knowledge on safe consumption of drugs and strengthen consumers' confidence in their product knowledge, so as to alleviate consumers' dependence on WOM. In particular, in the era with abundant online information, it is easy to obtain WOM. In the commercial operation model of manufacturers and through the marketing model featuring online shopping experts and WOM, the business reputation purposely manipulated by the manufacturers can easily become reference information for consumers; consequently, consumers would consume dietary supplements inappropriately, and may suffer from possible physical and mental health problems. Thus, consumers should be educated with appropriate knowledge about dietary supplement to prevent them from referring to incorrect information from WOM, and thus to danger their health.

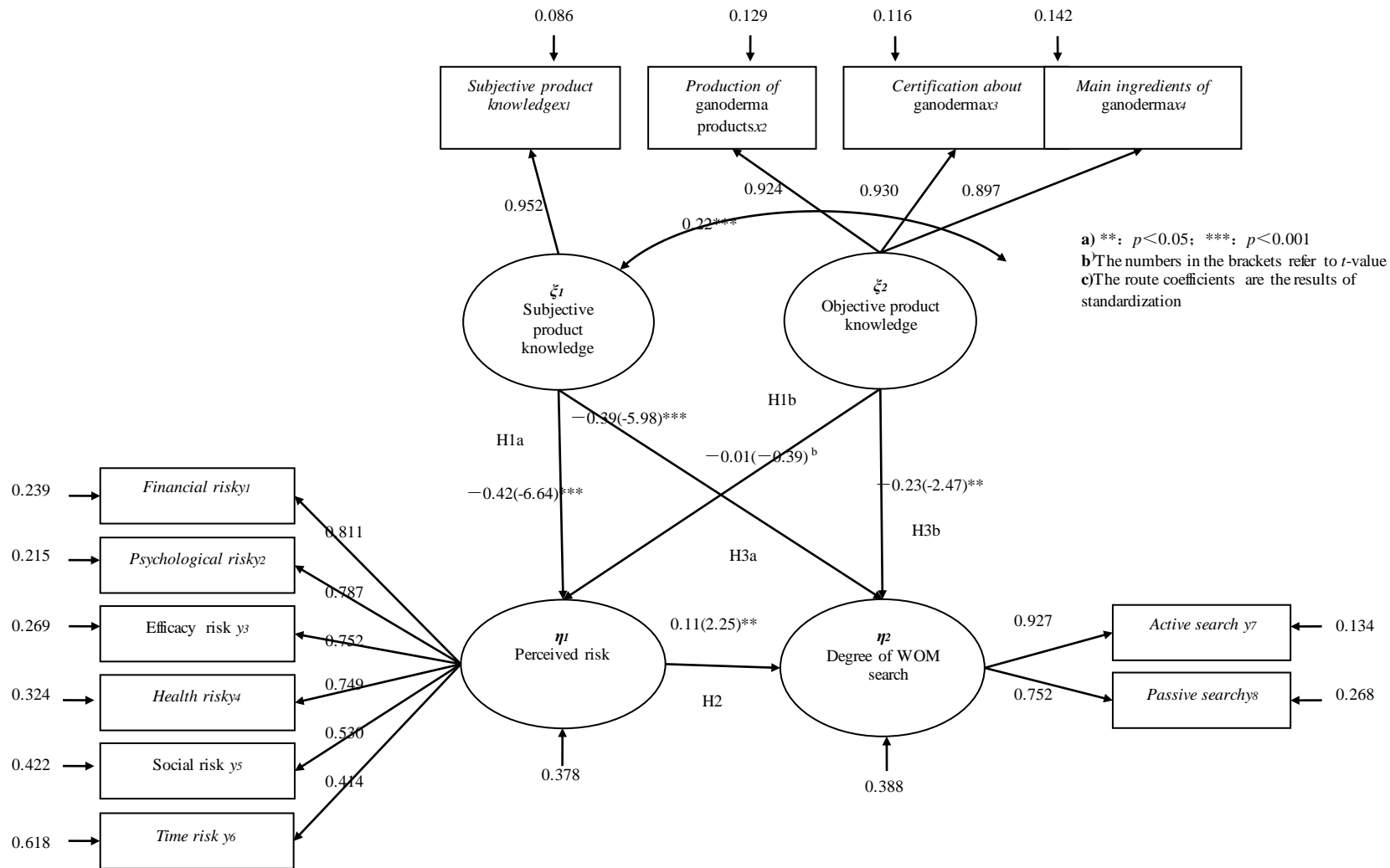


Fig.2. Causal relationship of product knowledge, risk perception and WOM search behavior

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