

Determining The Relationship Between Adoption Factors of P3 Sweetener through Partial Least Squares Structural Equation Modeling Approach

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Abstract

P3 Sweetener is categorized as a nanomaterial-based health and wellness product. It is also known as a nanofood product, used to intensify the nutritional content, quality, and flavor of food. However, minimal research, interest, and engagement have led to limited knowledge discovery, uncertainty, and lack of understanding on this matter. Thus, the present study is intended to investigate the relationship between adoption factors of P3 Sweetener towards the purchase behavior of the consumers. A conceptual framework was constructed based on the Stimulus Organism Response (SOR) model developed by Mehrabian and Russell in 1974. An online questionnaire was distributed online via Google Forms for data collection. This quantitative study involved 390 P3 Sweetener users who responded to the questionnaire distributed in Johor, Malaysia, based upon the purposive sampling plan (homogenous sampling). After discarding the incomplete questionnaires, approximately 365 samples were considered suitable for further analysis, which was performed using Partial Least Squares Structural Equation Modelling (PLS-SEM). Research result indicated that perceived benefit, motivation, and trust have significant relationships with purchase behavior. Also, it postulated that motivation was the most significant predictor for purchase behavior, affecting the psychological processes of the human mind and led to the willingness to purchase the P3 Sweetener. Despite the substantial contributions generated from the current study, limitations do exist. Firstly, the number of food industries related to nanofood in Malaysia is limited. Secondly, the data collection process was time-consuming. The appropriate samples and data collection took approximately six months to be completed due to their confidentiality. Lastly, this research was confined to Johoreans in the state of Johor, Malaysia. Finally, it indicated that this study is among the first to investigate the adoption factor of the P3 Sweetener product from the behavioral perspective. It also helps to comprehensively understand the adoption process of P3 Sweetener among users, especially in health and wellness industries in Malaysia. Lastly, this study helps to enrich the literature by identifying the adoption factors of P3 Sweetener in the health and wellness managerial context and provide recommendations for future studies.

Keywords: P3 Sweetener; Nanofood; Health and Wellness Product; Purchase Behavior

1. Introduction

The past decades have witnessed the progressive development of health and wellness products that would radically change the health and wellness industry. Health and wellness products are products that merge the food and beverage industry and the beauty product industry globally, and some of them are integrated with nanotechnology techniques (Ravichandran 2010). Manufacturers are revamping health and wellness products to lessen the cholesterol, sodium, sugar, and saturated fat content of food products due to an increase in people's health consciousness. Health and wellness products provide consumers with safe benefits along with innovations in various health and wellness products (Lau et al. 2013). In this study, P3 Sweetener was used as an example of a health and wellness product incorporated using nanotechnology techniques. It can be categorised as a nanofood-based health and wellness product. Nanofood is a functional food created by nanotechnology tools that cultivate and identify processes and thereby generate useful materials or techniques, using new attributes and

physical laws in order to create new materials (Kim & Lee, 2006; Hasim et al. 2020). In addition, it is known as food that was modified, processed, or manufactured by nanotechnology techniques or by food itself incorporated into nanomaterials (Sekhon, 2010).

P3 Sweetener is a health and wellness product that uses nanotechnology techniques. The product was produced by P Three Sweetener Global Sdn Bhd in 2013 and located at Megan Sri Rampai Setapak, Kuala Lumpur, Malaysia. The P3 Sweetener product was invented to meet everyone's needs. This product has entered the Malaysia market as the first in the world, introducing a sweetener that is entirely extracted from sugarcane, using sophisticated nanotechnology. The main purpose of the invention of this product was to replace white sugar and synthetic sweeteners with an alternative and primary sweetener. More importantly, this sweetener retains the original taste of our daily sugar (almost 99%), which has zero values of protein, sucrose, aspartame, monosaccharide carbohydrates, calories, saccharine, and additives (Hasim et al. 2019).

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However, previous studies have indicated that consumers have very limited knowledge of nanofood products (Van Giesen, Fischer, & Van Trijp, 2018). This contributes to the minimal studies conducted on the adoption of nanofood towards purchase behavior in the Malaysian market (Hasmin et al. 2020). Furthermore, previous researchers found that the application of nanofood has not been discussed and explored widely due to its limited utilization in food industries in Malaysia (Khezri et al. 2016). Thus, the adoption rate of nanofoods is still low. Although the application of nanofood is becoming popular among developed nations such as the USA, Japan, Europe and Taiwan, there is still a lack of consumer interaction and interest towards nanofood (Boholm & Larsson, 2019). They also lack the know-how of how nanofood is being incorporated in our daily lives (Pidgeon, Harthorn, and Satterfield, 2011). This is due to poor knowledge, unfamiliarity with the technology, and difficulties in understanding the concepts of the technology (Macnaghten, 2010; Duncan, 2011). Thus, further studies on the adoption factors of P3 Sweetener should be pursued. The presence of P3 Sweetener product among Malaysian consumers is still unclear, which can help to control blood sugar levels in our body and minimize the risk of sugar-related illnesses such as diabetes and high cholesterol. In order to tackle these problems, the manufacturer of P3 sweeteners should undertake more efforts to enhance consumers' understanding on the benefits of their product and their product's global visibility in the market. Thus, this study intends to examine the relationship between the adoption factors of P3 Sweetener and purchase behaviour.

2. Background

The literature review focused solely on scholars' publications. Although the literature on the subjects of this research is sparse, this study has examined the content of various works that relates to the research questions. Several areas that were examined include consumer perception of the use of food technologies and understanding and the degree of acceptance of nanotechnology techniques used in the food product. This section also reviewed factors that directly affect consumers' buying decision on nanofood products among the desired customers. After reviewing the literature, three relevant factors were derived as parts of the theoretical framework tested. The three identified factors function as independent variables and are presented as adoption factors, namely i) perceived benefit, ii) motivation, and iii) trust. The following section will discuss these adoption factors and the proposed hypotheses development which aim to answer the research questions.

2.1 Underpinning theory and hypotheses development

This study adapted the Stimulus Organism Response (SOR) model developed by Mehrabian and Russell in 1974. Initially, the main gist of the SOR model was originally based on stimulus-response theory (Mehrabian & Russell, 1974). This model explains how individuals react to external stimulation. Later, the SOR model was

enhanced by integrating the idea of organism between the stimulus and the response of Mehrabian and Russell in 1974. In this model, based on the SOR model, the formation of consumer behavior goes through three stages, which are stimulus, organism, and response. However, the response stage was excluded from this study. Stimulus represents the adoption factors that can influence an individual's understanding, perspective, and choice before purchasing a product or service and it is represented by perceived benefit, motivation and trust. Organism refers to the state of perception, sensation and internal thoughts, and those internal thoughts will influence the purchasing process, which has been presented as purchase behavior, in which it responds as an organism in this study.

Perceived benefit is one of the constructs formed in social science studies. Perceived benefit is defined as the positive effects of a particular action (Gellman & Turner, 2013). This construct was the most applied construct in human behaviour research (Gao et al. 2017). In this context, perceived benefit has a positive association with nanofood which helps the human body to absorb nutrition more easily and brings extra nutrition to the consumers (Singh et al. 2017). However, there are differences in how the consumers viewed the benefits of the food associated with nanotechnologies. A previous study done by Erdem (2018) has pointed out that some consumers expressed concerns over foods becoming toxic and causing damage to human health since they are unfamiliar with the context it is utilised which leads to fear of uncertainties and risks in the area of health and safety. Moreover, a study done by Handford et al. (2015) indicated that several consumers are misled by the concept of a food process that is integrated with nanofood due to uncertain risks and poor knowledge. These issues led to poor perception of nanofood products towards purchase behavior. Thus, it is necessary to clearly convey the benefits of the product to consumers, because most consumers depend on the health statements of the manufacturers before buying the product. Based on these arguments, this study postulates that:

H₁: Perceived benefit is positively related to purchase behaviour.

Next, motivation is defined as a set of psychological processes that drive a person's behaviour and describes the effects of psychological processes on the human mind and how it works, which leads to the willingness to buy (Roman & Lacobucci, 2010). In this study, motivation states are based on two dimensions which are brand and price (Bagdoniene & Zemblyte, 2009). Motivation can generate more value and lead to human desire which can affect buying behaviour (Close & Kukar-Kinney, 2010). Furthermore, the role of motivation has also been explained through the Maslow hierarchy theory, whereby motivation can influence consumer behaviour towards a specific action (Dima, Man, & Kot, 2010). Furthermore, research done by Haider & Shakib (2018) confirmed that motivation has a positive relationship with purchase behavior, through the product brand and the price offer. A good brand has a powerful attraction to influence

purchase behavior. Effective marketing techniques such as advertising and promotion may also affect consumer motivation towards purchase behavior. Based on previous findings, this study proposed the following hypothesis:

H₂: Motivation is positively related to purchase behaviour.

Lastly, trust is defined as a process, a system of controlling, authorizing, and shaping it to form a process of certainty and safe to be used by consumers (Edelenbos & Van Meerkerk, 2015). Trust happens at a specific time along the specific process within a specific timeline if it has met certain conditions (Roosen et al. 2015). Trust will be generated at a certain moment and will go through a certain phase before true trust is achieved. This section presents the importance of trust in facilitating consumer understanding of the concept of trust and how trust affects consumer’s behavior towards nanofood. Bredahl (2001) identified that trust has a positive association with purchase behavior. Trust has a clear structure to ascertain nanofood acceptance (Hasim, Jabar, & Murad, 2019). To build trust, the policymakers should promote and instill trust in scientists and deference to scientific authority among the public (Ho, Scheufele, & Corley, 2010). This issue must be addressed to ensure that consumers are aware of the scientific analysis of nanofood that has been produced by the manufacturer (Brankov et al. 2013) and realize nanofood is safe to consume daily (Wang, Shen, & Gao, 2018). Furthermore, Siegrist (2008) pointed out that the successful marketing of nanofood plays an important role in establishing trust. If people have trust in a product, it will satisfy its needs at some degree of efficiency. Hence, the product is deemed reliable. Based on these arguments, this study postulates that:

H₃: Trust is positively related to purchase behaviour.

Based on the above hypotheses, a conceptual framework was formulated as illustrated in Figure 1.

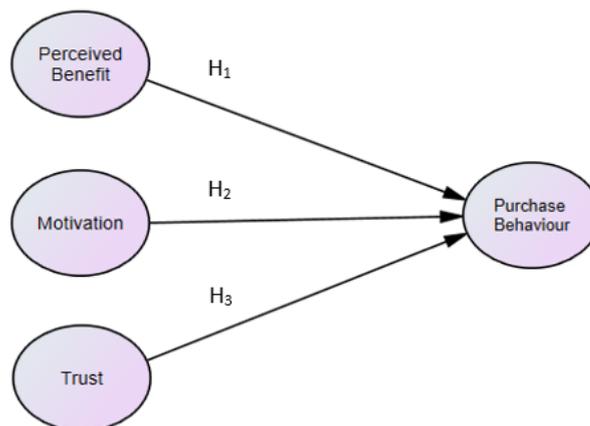


Fig. 1. Conceptual Framework

3. Research Methodology

3.1 Research instrument

The survey was split into two sections in this report. Part A captured respondents’ demographic characteristics such as age, gender, race and education, as shown in Table 1, while Part B discovers factors affecting the adoption of P3 Sweetener. In line with this, adoption factors (perceived benefit, motivation, and trust and) were taken from previously validated studies (Bagdoniene & Zemblyte, 2009; Brankov et al. 2013; Wee et al. 2014; Singh et al. 2017). As a result, fifteen (15) items were developed: perceived benefit (4 items); motivation (3 items), trust (5 items); and purchase behaviour (3 items). Furthermore, in order to measure these items, a 5-point Likert scale was used from 1 (strongly disagree) to 5 (strongly agree) and the questionnaire was sent for analysis by an expert (academic). Grammatical and structural improvements were conducted to ensure the respondents can understand the statements easier and made them more plausible. Finally, all items were revamped to suit the study context, as illustrated in Table 2.

Table 1
Respondent’s Profile

	Demographic characteristics	Frequency	Percentage %
Age	21-24	25	6.8
	25-28	51	14.1
	29-32	16	4.4
	33-36	90	24.7
	37-40	75	20.5
	41 and above	108	29.5
Gender	Male	187	51.2
	Female	178	48.8
Race	Malay	278	76.2
	Chinese	81	22.2
	Indian	6	1.6
Education Level	Non-high school graduate	45	12.3
	High school graduate	136	37.3
	Diploma	95	26
	Bachelor degree and above	89	24.4

Table 2
Research Instruments

Code	Items
Perceived Benefit	
PB1	I believe nanofoods provide additional nutrition,
PB2	I believe nanofood will boost the taste of foods
PB3	I believe nanofood will prolong the shelf life of foods
PB4	I believe that nanofoods have the benefit of helping the body more efficiently absorb nutrients
Motivation (Brand and Price)	
MV2	I like simple and concise products
MV3	I like to buy only well know products / services
MV4	I like to compare the prices offered before buying
Trust	
TT1	I trust in the scientific experiment of nanofood materials.
TT2	I trust in nanofood because of the brand (eg: P3 Sweetener)
TT3	I trust the product because I am aware of its quality
TT4	I have an experience in the use of nanofood before
TT5	I trust nanofood is safe to use
Purchase Behaviour	
PR2	I often buy nanofood products on regular basic
PR4	I often buy nanofood product that are safe to consume
PR5	I often buy nanofood product because they are more environmentally friendly

3.2 Sample Design, Data Collection and Data Analysis

The survey was distributed online using Google Forms. Google Forms is a web-based survey tool that allows respondents to quickly complete online questionnaires and respondents were informed of the objective of the study, and questionnaires were given to them. Google Forms will produce results and submit them to a professional as descriptive statistics or as graphical data. The findings can be downloaded as a table or database for further review. A total of 390 P3 Sweetener users responded to the questionnaire distributed in Johor based upon purposive sampling plan (homogenous sampling) and this study was carried out entirely quantitatively. Additionally, 365 were considered suitable for further analytical procedures after discarding the incomplete questionnaires. In this study, the minimum sample size required was 346 participants, as indicated by Krejcie & Morgan (1970) by taking account 95 % confidence level, standard deviation of 0.5, and a margin of error of $\pm 1\%$. However, this study managed to collect 365 responses after discarding the incomplete questionnaires. Hence, 365 samples met the recommended minimum sample size for sample adequacy. Furthermore, SPSS version 23.0 was used to process descriptive statistics and conduct reliability analysis, as well as to assess the demographic profile and internal accuracy of the constructs. Then, in order to analyse the research model, SmartPLS 3.0 software was used for Partial Least Squares (PLS) analysis. This study evaluated the measurement model (convergent validity) in accordance with the recommended two-stage analytical procedures for SEM and analysed the structural model (Hair et al. 2017). A bootstrapping approach (5,000 resamples) was used to assess the value of the route

coefficients and loads (Hair et al. 2013). Since Structural Equation Modeling (SEM) includes data that do not contradict normality assumptions, data normality was tested. Therefore, a partial least square (PLS) based SEM was used for this study. PLS is a validated method for estimating routing coefficients in structural models used in several research studies. Due to its ability to model latent structures in conditions of non-normality and small to medium sample amounts, PLS has become more prominent in marketing and management research in general in the last decade (Ali, Kim, & Ryu, 2016).

4. Results

This study has employed Smart-PLS 3.0 software to conduct Partial Least Squares analysis to calculate the models and evaluate the structural model. According to Hair et al. (2017) two measures should be followed, in which the measuring model was first examined to measure convergent validity and discriminant validity, and in the second phase, structural model analysis was performed to evaluate the structural model and the hypotheses developed.

4.1 Measurement model

The assessment of the measurement model includes an evaluation of the reliability and validity of building steps. In this research, a measurement model analysis of the four constructs was performed. The convergent validity was evaluated based on factor loadings, composite reliability (CR), and average variance derived (AVE). Table 3 shows that the recommended value of 0.6 is surpassed by all item loadings (Chin, Peterson, & Brown, 2008). Composite reliability values represent the extent to which the construction indicators indicate the latent construct

surpass the threshold value of 0.7, while the total variance for the latent building indicators exceeds the recommended value of 0.5 (Hair et al. 2010).

The next stage determines the discriminant validity, which refers to the extent to which the test does not reflect any other variables; a low correlation between the interest rate and the calculation of other buildings is seen. In this analysis, discriminant validity was evaluated by comparing the inter-correlation between constructs and their AVE square root (Fornell & Larcker, 1981). Table 4 shows that each construct 's square AVE root (diagonal values) is greater than its respective coefficients of correlation pointing towards ample discriminatory validity. Based on the recommendations of the measuring model, it is concluded that all constructs have achieved

substantial reliability and validity. Finally, the model is adequate for structural model analysis and hypothesis testing.

4.2 Structural model analysis

In structural model, Hair et al. (2017) proposed that a 5000 resample bootstrapping mechanism should be used for R², beta, and the corresponding t-values. As illustrated in Figure 2, the R² value of purchase behaviour is 0.484. This value approaches the threshold value of 0.333, which suggests a moderate model (Khalid et al. 2020). The path coefficient was then used to test the strength of relationships as illustrated in Table 5.

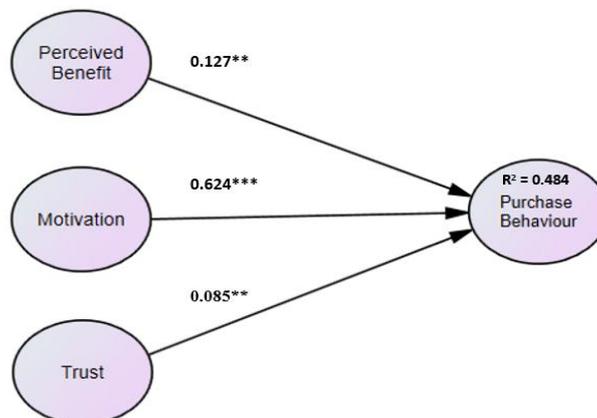
Table 3
Convergent Validity

Constructs	Code	Outer Loading	AVE	CR
Perceived Benefit	PB1	0.840	0.784	0.935
	PB2	0.916		
	PB3	0.887		
	PB4	0.896		
Purchase Behaviour	PR2	0.845	0.745	0.898
	PR4	0.862		
	PR5	0.882		
Motivation	MV2	0.856	0.750	0.900
	MV3	0.856		
	MV4	0.885		
Trust	TT1	0.839	0.649	0.902
	TT2	0.797		
	TT3	0.819		
	TT4	0.761		
	TT5	0.809		

Table 4
Discriminant Validity

Constructs	1	2	3	4
Perceived benefit	0.885			
Purchase behaviour	0.341	0.863		
Motivation	0.337	0.680	0.866	
Trust	0.040	0.187	0.154	0.805

*Values on the diagonal (bolded) are square root of the AVE while the off-diagonals are correlations.



Note: ***p<0.001, **p<0.05.

Fig. 2. Structural Model for The Direct Effect

Table 5
Structural estimates (hypotheses testing)

Path	β	t-value	p-value	Results
H ₁ : PT → PR	0.127	2.135	0.033	Supported
H ₂ : MN → PR	0.624	9.928	0.000	Supported
H ₃ : TT → PR	0.085	2.124	0.034	Supported

The structural model analysis demonstrated that perceived benefit ($\beta = 0.127$, $t = 2.135$, $p < 0.05$), motivation ($\beta = 0.624$, $t = 9.928$, $p < 0.001$), and trust ($\beta = 0.085$, $t = 2.124$, $p < 0.05$) were significant with purchase behaviour. Thus, H₁, H₂ and H₃ were supported, as illustrated in Table 5. This study has provided empirical evidence that supported the influence of perceived benefit, motivation, and trust as predictors of purchase behaviour. The result indicated that motivation was the most significant predictor for purchase behaviour. These findings are also supported by Lautiainen, (2015) indicating that a person is motivated to purchase an item due to the price offered, rather than the benefits of the product. Price significantly influences a consumer's buying decision. The price perception provides information about a product and gives customers a deep meaning (Kotler et al. 2019). Although some parts of the community are rather sensitive on price, some of them also refer to contents of the product before purchasing (Safitri 2018). Research done by Singh et al. (2017) have confirmed that if the content of nanofood is realized by consumers, it will further motivate consumers to repurchase, thus elevating the adoption of nanofood.

On a similar note, this study found out that perceived benefit and trust were influencing and significant factors. The outcome is consistent with Van (2016) indicating that perceived benefit has a positive association with trust towards nanofood product. This helps to facilitate consumer understanding on the concept of nanofood and how the products will benefit them. Research done by Siegrist (2008) pointed out that the successful marketing of nanofood products plays an important role in establishing trust. If people truly believe in a product and the product meets their needs to a certain degree of quality, thus the product is viewed as trustworthy (M.A. Hasim et al. 2019). In order to increase the perceived value of consumers, Boholm & Larsson (2019) recommended that the terms, nanoparticles and nanomaterials, should be specified and used consistently as a basis for mutual understanding between relevant regulators and parties. Furthermore, Reisch, Scholl, & Bietz (2011) indicated that the latest research on the potential benefits and risks of nanoproducts and nanomaterials should be translated into an easy-to-understand format for dissemination to consumers. This is to ensure that consumers understand and are conscious of the benefits of the product before purchasing (Verbeke 2010). In conclusion, these results are predictable considering that consumers are enlightened by the presence of the P3 Sweetener product.

5. Conclusion

Finally, the outcome upon Partial Least Squares (PLS) analysis has contributed to enrich the literature by identifying the adoption factors of P3 Sweetener in the managerial context. P3 Sweetener product significantly contributes to the health and wellness industry, which helps to control obesity-associated disorders and is suitable for those who practice a healthy lifestyle. This study has also sought to expand on previous studies by focusing on the influence of perceived benefit, motivation, and trust factors on consumers decision towards purchase behaviour. The findings of this study show that perceived benefit, motivation, and trust factors were important and relevant factors. Despite the substantial contributions generated from the current study, there are also some limitations in this study. Firstly, the number of food industries related to nanofood in Malaysia is limited. In this context, several food industries are thought to impede nanofood, especially in Small and Medium Enterprises (SMEs). The revolution may be restricted by scarce resources in SMEs, difficulties in research, and risk uncertainties toward safety. Secondly, the data collection process was time-consuming. Since P3 Sweetener data are confidential, it required approximately six months to complete the data collection process and collect the appropriate samples. Lastly, this research was confined to Johoreans in the state of Johor, Malaysia.

Therefore, in order to expand the P3 Sweetener market globally, an effective government policy is necessary for them to penetrate the global market. Government policy is important to ensure that the products and services produced are safe for use. In this study, P3 Sweetener has been introduced as one of the nanofood products in Malaysia. Nevertheless, there are still minimal rules and procedures on the use of nanofood products (Coles & Frewer, 2013). This issue makes it difficult for the public to understand nanofood and, consequently, more difficult to communicate about nanofood to everyone (Laux et al. 2018). There is no specific nanofood policies or initiatives that can be referred to as a guideline in Malaysia (Hamdan 2014). Thus, this issue needs to be tackled by the government and it must comply with good guidelines to effectively manage toxicity and safety to maintain the public trust of the P3 Sweetener product or related nanofood products. Furthermore, it important to engage with public trust to create specific initiatives on the P3 Sweetener product social media platforms such as Facebook, Twitter and Instagram, in order to gain

consumer attention towards P3 Sweetener product (Sridevi, Niduthavolu, & Vedanthachari, 2020).

In this scenario, it has been argued that trust must be established, and that transparency is a good way of doing so, especially to unfamiliar products. This is to ensure the public realized the existence of the P3 Sweetener product. Moreover, research done by Siegrist (2010) also emphasized the need to induce high public trust in government and regulation. It was also expected that new thinking on how to be proactive and transparent in communication and new relationships with the public can assist in incorporating and communicating research and risk assessment (Shatkin et al. 2010). Thus, trust is important in shaping acceptance and belief. By encouraging high public trust in government policies and regulations, issues related to limited knowledge, uncertainty, and lack of understanding of the context utilized in the P3 Sweetener products can be overcome successfully. Lastly, future research recommended that to use a mixed-methods approach to integrate the data between qualitative and quantitative through sequential exploratory design. Sequential exploratory design is an approach which use to connect qualitative and quantitative data collection and analysis in a sequence of phases. In fact, Alkrajji, Jackson, & Murray (2016) found using a mixed-methods approach could strengthen the findings and lead to better results. As a result, this approach has the potential to strengthen the findings by further reinforcing the results and understanding the contradictions between qualitative and quantitative data.

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