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Development of Consumer Packaging for Fresh Persimmons

Siriwan Tungsangprateep[1]*, Ratchaneewan Kulchan[1], Wasan Toonkham[1], Olarn Tuntawiroon[2], Weerasri Meaktrong[2], Bussakorn Praditniyakul[1], Pattra Maneesin[1] and Sakkhee Sansupa[1]

ABSTRACT

The consumer packages for fresh persimmons were developed according to the packaging requirements of the produce characteristics, produce developers, as well as market requirements with the aims of decreasing produce damage during transportation and improving sale promotion. The new die-cut style corrugated fibreboard boxes for containing eight persimmons were developed with inside dimensions of 310×175×60 mm. In addition, special partitions were placed inside to avoid produce shifting during transportation, together with ventilation holes help to prevent excess moisture content. The E flute - corrugated boards type DP310/CA125/KI125 were selected as packaging materials due to their low water absorption. The water absorption value was about 117 g/m^2 which was within the suitable ranges for fresh produce packaging. Foam net was used to wrap around each fruits to reduce impact and ensure tight packing of inside fruits during transportation. Besides its distinguish shape from the conventional packaging, all functional properties were also maintained e.g. containment, protection and sale promotion. The compression strength of the developed boxes was found to be 272 kg$_f$ providing enough strength to withstand occurring stress and pressure during storage, handling and transportation. In addition, the graphic design was developed in accordance with the structural design and consumer perceptions.

Key words: persimmons, consumer package, packaging development

INTRODUCTION

The promotion of growing temperate fruit crops in mountainous areas has been firstly started in Northern Thailand to reduce slash-and-burn cultivation by which the forest is destroyed as well as improvement in standard living of hill tribes who live in these areas. The promoted fruit trees such as peaches, Japanese apricots, Japanese plums and persimmons were successfully grown and extended to other critical areas. Firstly, high land areas in Phetchabun province were selected as target areas due to an obvious occurring of destroyed forest by slash-and-burn cultivation and climatic suitability for temperate crops. Among the tested crops (e.g. peaches, Japanese apricots and persimmons) growing on target areas, persimmon trees showed the highest potential productivity and feasibility in marketing thus they were selected for further development. Although persimmon fruits are under ripened picked, they are easily bruised and scratched by pressure and

[1] Thai Packaging Centre, Thailand Institute of Scientific and Technological Research, Bangkok 10900, Thailand.
[2] Agro-Ecological System Research and Development Institute, Kasetsart University, Bangkok 10900, Thailand.
* Corresponding author e-mail: siriwantung@yahoo.com

shifting of fruits during storage, handling and transportation, especially where the road condition from farm to market is very long and rough. Packaging development is very necessary to minimize these damages, ensure safe arrival and an attractive package is able to promote sales effectively (International Trade Centre, 2000). In addition, standardized packaging can help to increase market opportunity. Therefore, packaging development should be performed together with good agricultural practice for completely practical results.

The purposes of this study are to conduct a structural and graphic design for consumer package of persimmons and prepare art work for future production. The design is focused on both protective function as well as visual impact to promote sales.

METHODOLOGY

Required information for packaging design

The information on characteristics and marketing of persimmons and present status of utilizing packaging for fresh fruits in local market was gathered from literature and by qualitative research and summerized to find the packaging requirements and design concepts for consumer packaging development. The qualitative research was carried out by interviewing two produce developers and ten owners of retail shops in fresh market. The major fresh market for high price fruits in Bangkok- "Bon Marché" was selected as representative for this study. Twelve interviews were conducted in total.

Packaging development

Principal concept design

The design concept was created from analyzing the gathered information.

Defining of packing size and dimensions

The packing size was defined based on the suitability for single time buying. Then, the dimensions were defined by using the persimmon model of Fuyu (extra grade) from the Royal Project Foundation.

Packaging material selection

Based on the gathered information and comments from three packaging specialists and one packaging designer from Thai Packaging Centre (TPC), the appropriate materials were selected for their optimum protection performance, printability and price.

Water absorption test

The four types of available corrugated fibreboard were tested for their water absorption using Cobb method (ISO535: 1991(E)) to select an appropriate one for making the packages.

Box compression test

Five samples of the developed empty boxes making from DP310/CA125/ KI125 were evaluated for their compression strength according to a method of ASTM D 642-00 and reported in kg_f. The average value was used for calculation the number of stacking using maximum safety factor of 10 (Clarke and Marcondes, 2005) following the calculating procedures suggested by Suthus N. Ayuttaya, 2005.

Structural and graphic designs

Five drawings of consumer packages were sketched in accordance with the gathered information of packaging requirements. The prototypes were made and used for verifying the consumer perceptions by a survey conducted in Bangkok and Phetchabun with 200 respondents (tourists or buyers in fruit retail shops, age between 30-50, males or females). The two prototypes of highest acceptant scores were selected.

One effective design with higher possibility in commercial uses as well as protective properties was chosen for further developing. The selected design was revised step by step to improve all of the basic functional properties and an attractive image of the packages. The prototype

for final structural design was made.

Three different graphic designs were developed according to the final structural design. The prototype of three graphic designs were made and used for a survey conducted in Bangkok to evaluate the consumer acceptance with 100 respondents (buyers in fruit retail shops, age between 30-50, males or females).

For each developing step, the selection was made by three packaging specialists and one packaging designer from TPC according to the mentioned criteria as shown in Fig.1 and 3. The final decisions were finished when at least two from four committees agreed with the results.

RESULTS AND DISCUSSIONS

Required information for packaging design

Results from Table 1 indicated that the developed packages were required to withstand pressure and handling stresses to protect the inside fruits against damage during storage and transportation. Tight dimension of the packages was also important to help to decrease in bruising due to fruit shifting during transportation. In addition, visual design for the packages was necessary for effective promotion of the produces. Thus, a package appeal needed to be attractive and convenient to handle and use. Besides, it should have high quality expensive look, visibility and appearance of the inside fruits and finally make a good gift pack.

Packaging development

Consumer package developing was conducted based on the result of analyzed information from the study in Part 1.

Principal concept design

The package development on structural design emphasized on economically basic functional property fulfillment with attractive, unique and distinguished style. An additional visibility and appearance of the inside fruits, including good gift pack feature were considered. A design of graphic for the packages had to create visualized Phetchabun province scenery.

Defining of packing size and dimensions

Packing size and dimensions of the packages were defined in accordance with the results in Table 1. The packing size was defined to be four or eight fruits which approximately weighed 0.5 or 1 kg to satisfy consumer buying behavior. In addition, such weight was not too heavy to carry for single time buying. Therefore, the box dimensions were defined to have enough inside space for containing four or eight fruits using the persimmons variety model of Fuyu which was bigger than varieties P-2 to ensure appropriate dimensions for both varities.

Packaging material selection

Single-wall corrugated fibreboards (E flute) were chosen for materials in package construction because of their suitability for consumer packages and several advantages such as high protective strength, high printability, economical prices and domestic availability.

Water absorption test

The water absorptions for 1,800 seconds of four board types were shown in Table 2. The values showed that water absorption of both DP310/CA105/KI125 and DP310/CA105/KS170 were below the maximum recommended values of 150 g/m^2 (Kamolratanakul, 1990). However, price of DP310/CA105/KI125 was generally lower than DP310/CA105/KS170. Consequently, DP310/CA105/KI125 was selected for package making.

Box compression test

The average compression strength was 272 kg_f which could withstand 15 stacking layers under extreme conditions. This indicated that the box has enough strength to withstand stress and pressure during normal storage, handling and transportation.

Table 1 Required information for consumer package development of fresh persimmons.

Descriptions	Details
1. Produces	
• Target produces	- Fresh persimmons variety P-2, extra grade and Fuyu, standard grade 1 (Tuntawiroon, 2001).
• Risks of damage	- Bruising and scratching from shifting of fruits during transportation or pressure and stress during storage and handling. - Excess moisture loss results to over dried stalk or fruit. - Too soft flesh caused by over ripening.
• Protective requirements of the packages	- Enough strength to withstand stress and pressure from compression during storage, handling and transportation. - Tight dimensions to help to reduce unnecessary losses from bruising due to fruit shifting. In addition, an optimum size lead to decrease in waste of packaging materials and unnecessary transportation costs.
2. Packaging requirements of retail traders, produce developers and consumers	
• Packing size/ Dimensions	- Four or eight fruits/pack (approximately weight 0.5 or 1 kg) which is suitable for single time buying. - Box dimensions were defined by using the persimmon model of Fuyu (extra grade) from the Royal Project Foundation.
• Concept	- Suitable for use as gift package for all age and gender. - Create an imagination of natural scenery and symbol of Phetchabun province. - Provide visibility and appearance of the inside fruits as well as convenience for handling. - Attractive, unique and easy to recognize.
3. Marketing	
• Price	- Astringent varieties (e.g. P-2) approximately 30-60 baht/kg. - Non-astringent varieties (e.g. Fuyu) approximately 100-120 baht/kg
• Target customers	- All age and gender to promote persimmon consumption.
• Target market	- Firstly launch in Phetchabun province to create an image of gift from original growing areas-Phetchabun.
4. Currently consumer packages available in local market	
• Typical packages	- Plastic bags, foam trays, thermoform trays, mould pulp trays and corrugated boxes.
• Graphic design	- Pictures of inside fruits are normally placed as major composition. - Most are colorful with warm tones to give feeling of fun, fresh, cheerful and lively. - Red, orange and yellow tones are generally used for persimmons and similar fruits such as oranges.

Structural and graphic design

The schematic approach for structural design and consumer perceptions of the developed packages are presented in Figure 1 and Table 3 respectively. The designing approach covered sketch design drawing, prototype making, consumer perception survey and design development. Finally, the final design was developed as seen in Figure 2. The beautiful scene of Kao Kho, a famous tourist resort in Phetchabun, was used as a background for developing three styles of graphic design showing in Figure 3. Based on consumer perceptions (Table 4), the design B was selected due to its highest acceptance for making the final prototype and preparing artwork for further production in commercial scale. In addition, specifications of the finished design are provided in Table 5.

CONCLUSIONS

The development of consumer packages for fresh persimmons was emphasized on new and distinguished style as well as proper protection and containment. Both structural and graphic design were differentiated from conventional fresh fruit packages in local market in order to create attractiveness in first time launching and build brand royalty for repeating buying.

The new die-cut developed packages were unique, attractive and conformed to packaging requirements of produce developers, retailers and consumers. In addition, it was able to achieve four basic functions of good packaging as well as customer acceptances. The inside and outside dimensions of the package were 310 × 175 × 60 mm and 325 × 180 × 60 mm respectively. A special design of knocked down handles was performed for convenient handling, visibility and appearance of inside fruits, good gift pack feature and additional ventilation areas. Moreover, the special design partitions were also placed inside to protect fruits from shifting during transportation. To ensure protective performance of the boxes,

Table 2 Water absorption for 1,800 seconds of selected corrugated boards.

Board types*	Water Absorption (g/m^2)	
	Outside	Inside
DP310/CA105/KI125	117	117
DP310/CA105/KS170	117	99
DP270/CA105/KI125	153	118
DP270/CA105/KS170	161	98

* DP(Duplex), KI, and KS refer to types of paper for facings or liners. CA is type of paper for corrugating mediums. The following numbers refer to grammage of the paper in g/m^2.

Table 3 Average preferences scores of respondents to structural design of the developed packages.

Attributes	Designs*				
	Design 1	Design 2	Design 3	Design 4	Design 5
Box styles	2.3^{a}	2.8^{b}	3.8^{c}	3.2^{d}	3.0^{db}
Convenience to handling	1.7^{a}	3.6^{b}	4.2^{c}	3.0^{d}	2.6^{e}
Overall preferences	2.2^{a}	3.0^{b}	3.9^{c}	3.1^{b}	2.8^{b}
Preferring to buy	1.9^{a}	3.2^{b}	4.0^{c}	3.1^{b}	2.5^{b}

* Value in same row not followed by the same letter is significantly different ($P \leq 0.5$).
Preference score meanings: 1 – little like, 2 - like, 3 – moderately like, 4- very much like, 5 - extremely like

additional foam net was also used as packing materials. The single wall corrugated fibreboard type DP310/CA105/KI125; E flute was selected for making the packages. The compression strength of the developed boxes was about 272 kg_f providing enough strength for normal conditions of storage, handling and transportation.

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Table 4 Average preferences scores of respondents to graphic design of the developed packages.

Attributes	Designs*		
	Design A	Design B	Design C
Graphic styles	1.4 [a]	2.5 [b]	2.2 [c]
Color tones	1.3 [a]	2.6 [b]	2.1 [c]
Compatibility between graphic and box styles	1.3 [a]	2.6 [b]	2.1 [c]
Overall preferences	1.3 [a]	2.7 [b]	2.1 [c]
Preferring to buy	1.3 [a]	2.7 [b]	2.0 [c]

* Value in same row not followed by the same letter is significantly different ($P \leq 0.5$).
Preference score meanings:1- like, 2 – moderately like, 3 - extremely like

Table 5 Specification of finished packages.

Descriptions	Details
• Style	Die-cut box with special handles which designed for convenient handling
• Box Dimensions, (mm)	
- inside	310 × 175 × 60
- outside	325 × 180 × 60
• Packaging material	Corrugated fibreboard, E flute
• Board type	DP310/CA105/KI125
• Water absorption of board (g/m^2)	
- inside	117
- outside	117
• Compression strength (kg_f)	272

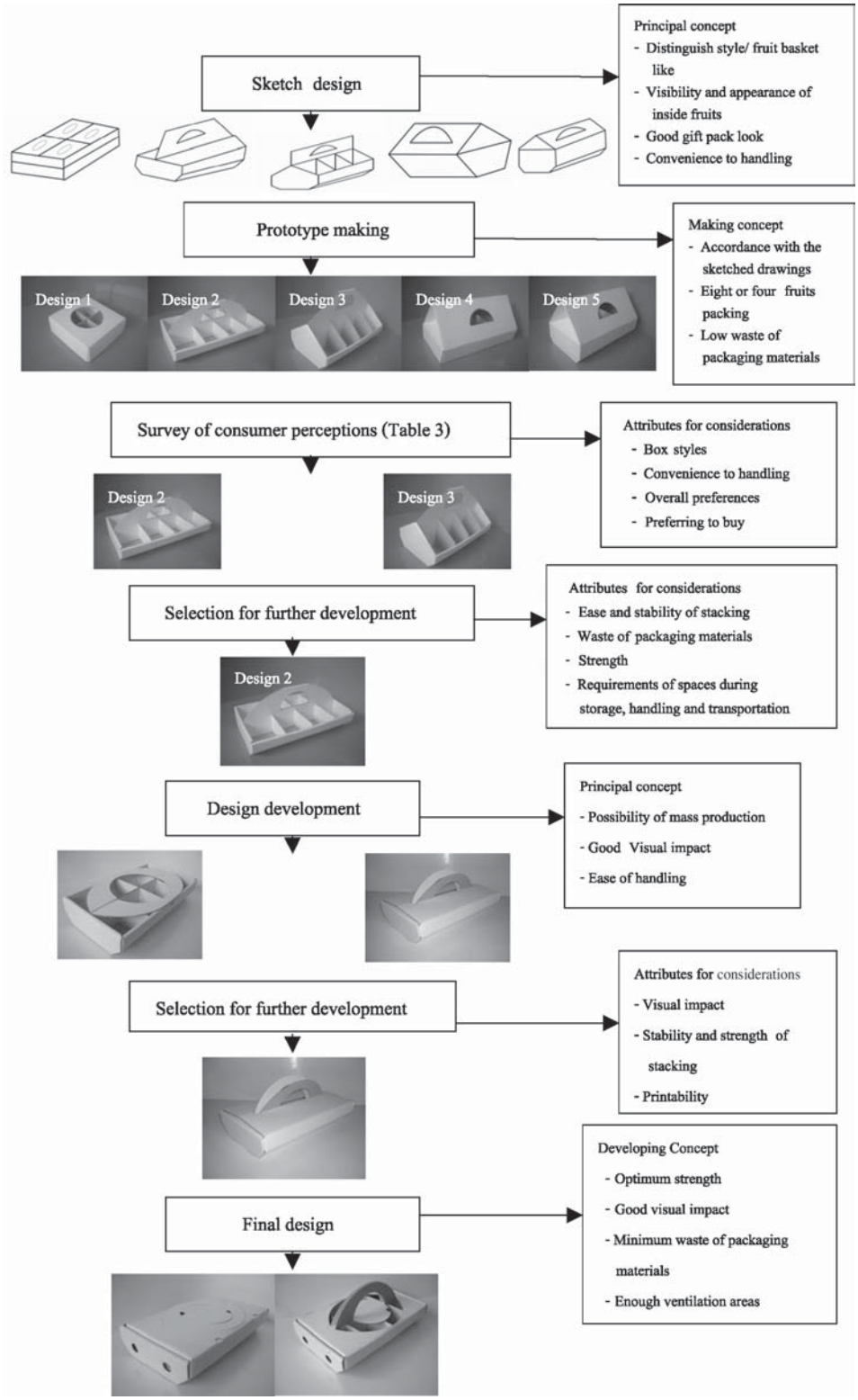

Figure 1 Schematic of structural development of consumer packages for fresh persimmons.

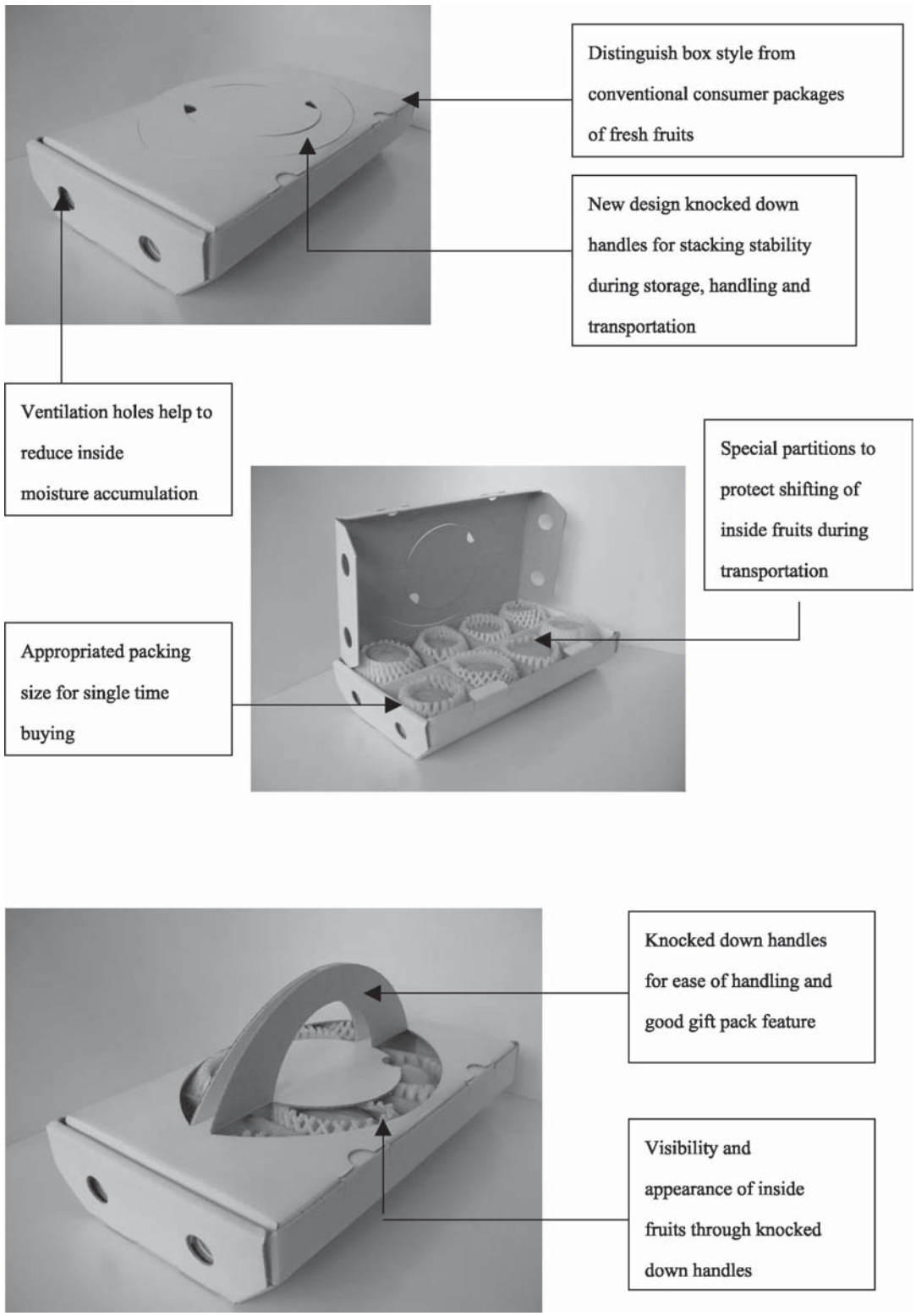

Figure 2 Final prototype of the structural developed package.

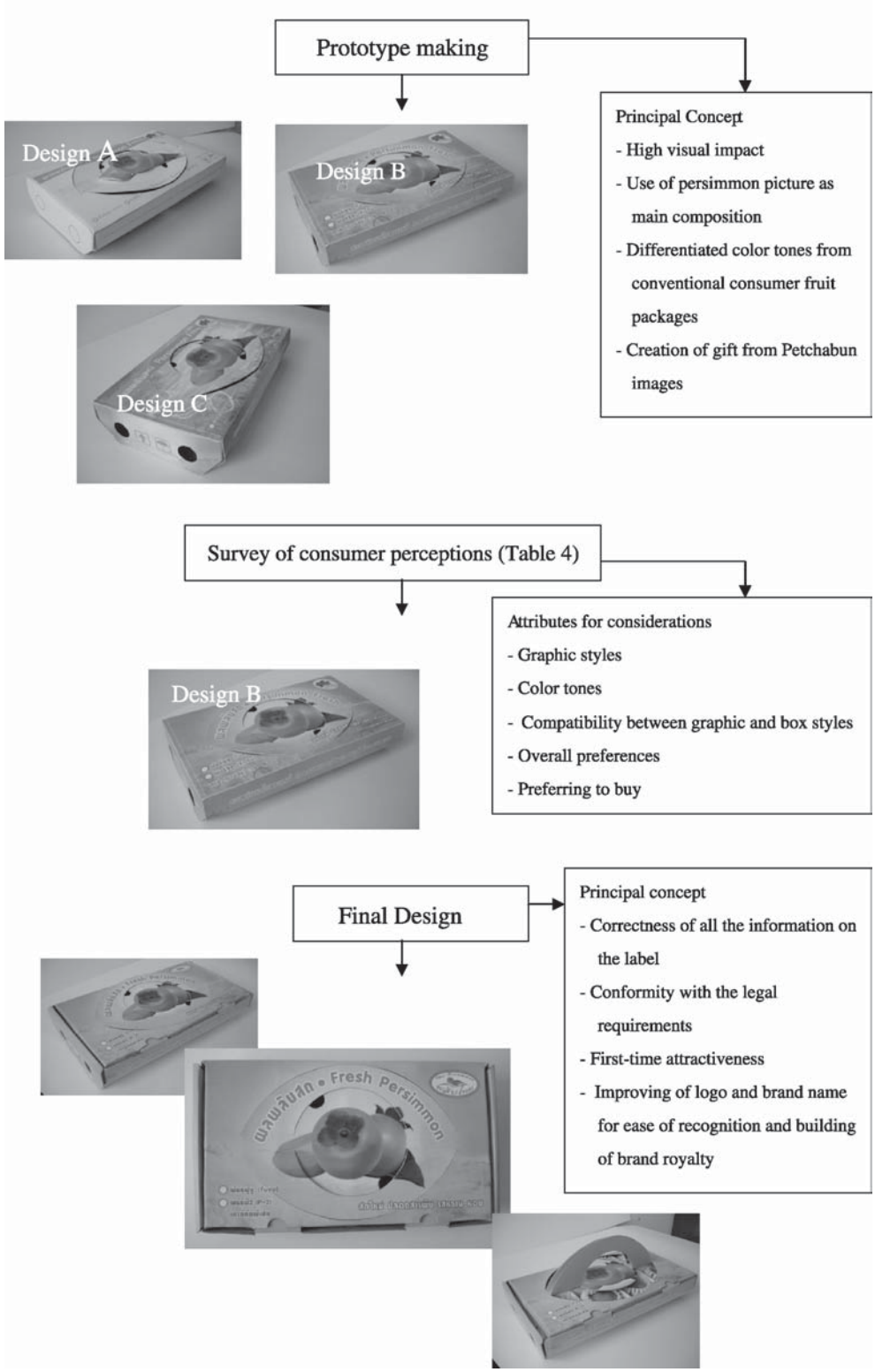

Figure 3 Schematic of graphic development of consumer packages for fresh persimmons.

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