DISCUSSION ON THE COLOR EMOTION OF TASTE IN FOOD PACKAGING

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Abstract - Packaging design is the key to purchase food, andcolor is the most direct visual stimulation in packaging. Color can affect people perception and purchase desiring. This experiment is to understand the relationship between packaging color and taste association, and this experiment used the PCCS color system that is more common in packaging applications. We use aluminum cylindrical form as the sample and match the color on the food and drink packages. Selecting colors include six colors of red, orange, yellow, green, blue and purple in the bright tone to doInvestigation report.The data use one-way ANOVA to analysis. The results is that food packaging about sour feeling are suitable for yellow tone; bitter feeling are suitable for green tone; spicy feeling are suitable for red tone.Sweet food in the men market can use orange color to wrap sweet food or drink.We provide relevant information to commercial designers and packaging designers.

Keywords - Package design; Visual color ; Color perception; Emotion feedback; Practical Color Co-ordinate System

I. INTRODUCTION

Packaging helps consumers identify the product type, use model and attract the attention of consumers, so packaging design is the key to purchase food, which includes color can be given people vision in the first time and be had enough impressions[1]. Difference of food packaging design is tuned to promote sales and enhance the competitiveness of goods in today's society.

II. LITERATURE REVIEW

Packaging is combined Structural mechanics, Aesthetics, Psychology, Human-factors engineering etc. to complete the appropriate package type to achieve protection of goods, pay attention on products, increase external value, and guide customers to understand the contents[2], so packaging design can attract customers in first visual. In visual packaging design, it has six main elements in Fig 1, including structure design and graphic design[3].

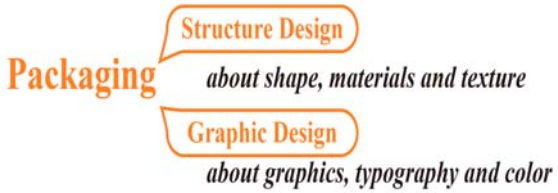


Fig 1. Packaging design elements[3]

However color is the most direct visual stimulation in packaging. The color element in packaging is recognizable, perceptual and symbolic[4]. In addition to the versatility of general packaging principles, food packaging also needs to consider color image, color association and color preference for helping people interprete of the product image and make choice quickly as shown Fig 2.



Fig 2. Color emotion feedback [5]

Because color packaging has the effect of attracting customers, many companies choose special colors to create the difference feature and increase sales in the market[6]. Especially in the packaging of foods, the color is divided into three parts: main color, auxiliary color and embellishment color. However, in the color planning can affect consumer to judge on the content about food, especially the main color on the package.The main color of the package enhances the symbolic meaning of food identification and taste feeling. Based on the above description, the main color is used in the packaging to help sale product, spread information to consumer, increase the readability of information and Cause purchase desire.

Basic attributes of color is Hue, Lightness and Chroma [7][8], it is can assist in color communication, achieve color coordination and harmonic effect.Moreover, color of Lightness and Chroma affect color quality about softness and hardness. For example, the color is high brightness and low purity which give people a soft feeling; the color is low brightness and high purity which give people a strong feeling[9].

So different colors also have different visual feelings, such as red, orange and yellow color can give warm feeling is belonged color system in warm tone; blue and purple color can give cool feeling is belonged color system in cool tone; green and purple color is belonged neutral tone[10]. In addition to color-related theory, color systems are an important part of the designer's plan for color, such as Munsell, PCCS and CIE color system, etc, PCCS color system as shown

Fig 3.

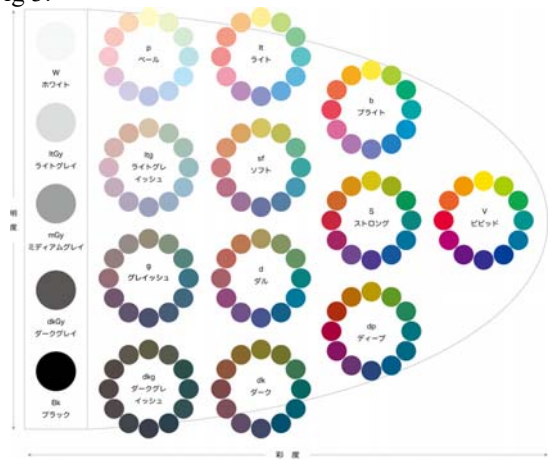


Fig3.Practical Color Co-ordinate System [11]

PCCS color system(Practical Color Co-ordinate System) was established by the Japan Color Association and is often used in the packaging aspect today. This PCCS color system contains the advantages of Munsell and Ostwald system, integrating elements of Lightness and Chroma.In the past, scholars have studied the emotional feeling of the PCCS color system, such as bright color in PCCS color system can give clarification and brilliance to people, so this color tone can be applied to food packaging [12], as shown in Table 1.

Table 1. Color emotion of PCCS color system[12]

Color tone	Color emotion
Vivid color	Bright, happy, lively
Bright color	Clarified, glorious
Strong color	Mature, gorgeous
Deep color	Rich, thick
Light color	Sweet, dreamy
Dull color	Stable, silent
Dark color	Stable, elegant
Pale color	Soft, slender
Light Grayish color	Simple
Grayish color	Withered, plain
Dark Grayish color	Heavy, serious

People in different colors have different emotional perceptions and perceptions [13], such as the presentation of food types, attributes, tastes, etc.The color of the package shows the symbolic meaning of the product is not to create recognition, so there is a positive significant correlation between color and purchase behavior [14], and can be linked to other senses through visual stimulation. For example,the color of the fruit is almost warm, so the manufacturer will choose red, yellow and green color as the main packaging color onjuice[15]; another study in the past was about chocolate packaging that the dark color packaging gives a bitter taste perception; the light or warm color gives sweet for people; the other study in the past was aboutbeverage packaging between drink taste and color [16], as shown in Table 2.

Table 2. Color association of soda[16]

Soda characteristics	Positive results	Negative results
Sweet	Red, orange	Green, brown
Sour	Green, yellow	Red, blue
Bitter	-	Red, blue
Salty	White	Red, green
Citrusy	Yellow, orange	Red, blue
Syrupy	Brown	Green, blue
Fruity	Red, yellow, orange	Brown, black
Bubbly	-	Red, green

On the whole, different packaging colors will trigger different taste sensations and affect the desire to purchase or content cognition about food. The taste buds of human can feel four different tastes, which are sour, sweet, bitter and salty. All tastes are made up of four basic tastes - sour, sweet, bitter and salty[17][18].Spicy taste is a kind of pain not part of the taste, but it often appears on food packaging.So this study will explore relationship between color and taste feeling to understand packaging color associations for food and beverages about consumers. Taste feeling is about sour, sweet, bitter, salty and spicy.Color type is about warm tone, cool tone,and neutral tone.

Although color perception may vary depending on factors such as personal experience or social background[19], if people take the group perspective as a result of the survey, they can still sum up the common feelings and tendencies of human color[20][21]. This study used the PCCS color system for experiments because this color system is more common in packaging applications and making the research results is more accurate, reliable and easy to verify. We hope that the research results can be provided to commercial designers and packaging designers toprovide relevant information.

III. METHOD

In this study, the taste of the taste (sour, sweet, bitter, salty and spicy) and the P.C.C.S Practical Color Coordinate System of food and beverage packaging color were used in the questionnaires. Before the color perception about packaging questionnaires, we first select the experimental packaging materials. The supermarket survey found that most of the plastic packaging was filled with sweet, spicy, salty, sour and bitter food or drink; glass packaging was filled with sweet, spicy, salty, sour and bitter foods and just filled milk type of drink. Aluminum can packaging was filled withsour, sweet, bitter, salty and spicy food or drink; paper material packaging just filled with sweet food or drink. According to the survey results, we selected aluminum can to be packaging material sample. Because plastic packagingis transmittance and

easily affected by light, it also has a larger shape change. However, aluminum material on packaging is not easily affected by light and the experimental results, it also has not much change in shape, so it is easy to do experiment on packaging color perception.Market survey results is shown in Table 3.

Table 3. Packaging about some materials

Material type	food	drink
Plastic	 Cylindricalform	 Curvedform
Glass	 Hexagonalform	 Curvedform
Aluminum	 Cylindricalform	 Cylindricalform
Paper	 Square form	 Square form

Therefore, we will use aluminum cylindricalformas the sample for this study, and match the color on the food and drink packages.The colors include six colors of red, orange, yellow, green, blue and purple in the bright tone of PCCS on aluminum can packaging, as shown in Table 4.Later, the experiment was conducted using the Likert five scale, “1” point means very disagree and “5” point means very agree.

Table 4. Experimental sample to use bright tone of PCCS

PCCS color	Bright Red	Bright Orange
Food / Drink Packaging		
PCCS color	Bright Yellow	Bright Green
Food / Drink Packaging		
PCCS color	BrightBlue	Bright Purple
Food / Drink Packaging		

Participants are student in Tatung University. The number of experiments is 30 people (15 men and 15 women) that scale of men and women are equal.The overall age is 22±2years old. This experiment is to understand the relationship between packaging color and taste association, and construct an association system about color and consumers taste perception.

IV. RESEARCH RESULTS

After experiment, we use one-way ANOVA to analyze the color perception packaging questionnaires

and with a more conservative view (α = 0.01) to analyze.

Overall results are significant($p<0.01$), as shown in Table5.

Table 5. Questionnaires ofresult aboutcolor perception

M(SD)	Sour	Sweet	Bitter	Spicy	Salty	P
Red	2.4(1.6)	2.8(1.2)	1.6(0.9)	4.9(0.1)	2.1(0.8)	0.00**
Orange	3.8(1.5)	3.9(1.1)	1.9(1.6)	2.2(1.4)	2.4(1.4)	0.00**
Yellow	4.5(0.9)	3.6(0.9)	2.8(1.6)	1.5(0.8)	2.0(1.3)	0.00**
Green	3.4(2.1)	1.9(1.4)	4.1(1.2)	1.6(1.0)	2.1(1.4)	0.00**
Blue	2.1(1.5)	2.8(2.3)	2.7(2.5)	1.2(0.1)	2.6(2.3)	0.00**
Purple	3.2(1.9)	3.4(1.7)	2.6(1.8)	1.2(0.2)	1.9(1.0)	0.00**

**P<0.01

The findings indicate thatred color of PCCS color system has a direct connectivity to the spicy taste, and the quality is very high in 4.9 points.The packaging color of orange does not connect in the sense of taste, but sour perception has a score of 3.8 on orange packaging and sweet perception has a score of 3.9 on orange packaging, so orange color may produce a sweet or sour feelingon food or drink packaging and close to the agree position (agree point=4).The yellow color of PCCS color system has a direct connectivity to the sour taste, and the quality is very high in 4.5 points.The green color of PCCS color system has a direct connectivity to the bitter taste, and the quality is very high in 4.1 points.The blue packaging color is not prominent in the taste, and all taste sensations do not agree(disagree point=2). The packaging color of purple does not connect in the sense of taste, butsour perception has a score of 3.2 on purple packaging and sweet perception has a score of 3.4 on purple packaging, so purple color may produce a sweet or sour feeling and close to agree position (agree point=4), as shown in Table 6.

V. DISCUSSION

In the results, it is described that the color of the red package can associate with the taste of the spicy, the yellow gives the taste association of the acid, and the green gives the bitter taste association. We want to know if the gender factor will affect the result, and to understand whether there is any difference between men and women's associations with colorperception. So, we use one-way ANOVA to analyze the relationship between color and perceived gender factors, it is with a more conservative view (α = 0.01) to analyze, as shown in Table 7.

Table 7.Color packaging of perception about gender

P value	Red	Orange	Yellow	Green	Blue	Purple
Men	0.00**	0.00**	0.00**	0.00**	0.03	0.00**
Women	0.00**	0.01	0.00**	0.00**	0.04	0.00**

**P<0.01

Red's packaging perception association with gender is significant ($p<0.01$). In spicyperception, the mengive 4.80 points and the womengive 4.9 points, so it has the same colorperception in gender that they contact red packaging to get spicy perceptual association. Another results that sour, bitter and salty feeling on gender factor are same perceptual association. They contact red packaging not to get sour, bitter and salty feeling. In thesweet part on red packaging, women's sense level is more than men's. Women's feeling is onnormal position (M=3.2), but men's feeling is on disagree position (M=2.5), analysis result about red color as shown in Table 8.

Table 8. Gender color analysis result about red color

Red	Sour	Sweet	Bitter	Spicy	Salty	P
Men	2.5	2.5	1.4	4.8	2.2	0.00**
Women	2.3	3.2	1.8	4.9	2.0	0.00**

**P<0.01

Men's perception of orange packaging is significant ($p<0.01$), but women's do not. On sweetassociation, men give 4.1 points, so they contact orange packaging to get sweet perceptual association.Sweet food in the men market can use orange color to wrap sweet food or drink, as shown in Table 9.

Table 9. Gender color analysis result about orange color

Red	Sour	Sweet	Bitter	Spicy	Salty	P
Men	3.7	4.1	1.8	2	2.3	0.00**
Women	3.8	3.6	2	2.3	2.5	0.01

**P<0.01

Yellow's packaging perceptionassociation with gender is significant (p<0.01). In the sour part on yellow packaging, the men and women feel 4.5 point, it has the same association.In addition, women think that bitter feeling on yellow packaging is on normal position, which is different from that result of men. The other taste feeling are same results on gender factor, they think thatyellow packaging on sweet, spicy, and salty association does not give them foodfeeling, the analysis result aboutcolor perceptual association as shown in Table 10.

Table 10. Gender color analysis result about yellow color

Yellow	Sour	Sweet	Bitter	Spicy	Salty	P
Men	4.5	3.7	2.4	1.4	1.8	0.00**
Women	4.5	3.4	3.2	1.6	2.1	0.00**

**P<0.01

Green's packaging perceptionassociation with gender is significant (p<0.01). In bitterperception, the mengive 4.2 points and the womengive 3.9 points, so it is different toassociate feelingin taste about gender factor. Another results that sweet, spicy and salty feeling on gender factor are same feeling on disagree position (M=2),so they can't associate with green packaging on sweet, spicy and salty feeling. In sour part on green packaging, women's sense level is as same as men's on normal position. Average ofwomen's feeling is 3.5 point, andthe part result of men is 3.2 point, as shown in Table 11.

Table 11. Gender color analysis result about green color

Green	Sour	Sweet	Bitter	Spicy	Salty	P
Men	3.2	2.0	4.2	1.4	2.0	0.00**
Women	3.5	1.8	3.9	1.8	2.2	0.00**

**P<0.01

Purple's packaging perceptionassociation with gender is significant (p<0.01). The results about bitter, spicy and salty are same perceptual association on purple packaging. They contact purple packaging not to get bitter, spicy and salty feeling.In the sweet part on sweet packaging, women's sense level is more than men's. Women's feeling is onnormal position (M=3.9), but men's feeling is on disagree position (M=2.8), analysis result about purple color as shown in Table 12.

Table 12. Gender color analysis result about purple color

Green	Sour	Sweet	Bitter	Spicy	Salty	P
Men	3.2	2.8	2.4	1.1	2.2	0.00**
Women	3.2	3.9	2.8	1.3	1.6	0.00**

**P<0.01

On the whole,sour foodpackaging are suitable for yellow tone, and red and blue toneare not recommended. Sweet foodpackaging are not recommended in red, green, and blue tone. Bitter foods are suitable for use in green packaging, and other colors tone are not recommended. Spicy foods are suitable for use red tone, and others are not recommended. And then, salty tastes show that are not suitable for use.And then, we compare with other scholars about this result, we find that yellow tone can be associated with sour perception, and can't use red and blue tone. Green tone can't be associated with sweet perception; red and blue tone can't be associated with bitter and salty, as shown in Table 13.

Table 13. Color associationabout soda, food and drink

Positive	Soda packaging	Food and drink
Sour	Green, yellow	Yellow tone
Sweet	Red, orange	-
Bitter	-	Green tone
Spicy	-	Red tone
Salty	White	-
Negative	Soda packaging	Food and drink
Sour	Red, blue	Red, blue tone
Sweet	Green, brown	Red, green, blue tone
Bitter	Red, blue	Red, orange, yellow, blue, purple tone
Spicy	-	Orange, yellow, green, blue, purple tone
Salty	Red, green	Red, orange, yellow, green, blue, purple tone

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CONCLUSION

All in all, use yellow tone on the sour diet package to let the customer feel the association. It is not recommended to use the red and blue tone as the sour package color. The sweet taste is not suitable for the green color as the packaging color, the bitterfood is not suitable for the red and blue color packaging, and salty taste is not suitable for the red and green color on the packaging, as shown in Table 14.

Table 14. Color association about food and drink

Sour	Bitter	Spicy
		

We hope that the research results can be providedrelevant informationto commercial designers and packaging designers. In the future, we will explore the degree of PCCS color tone difference on packaging color to associate about vision andtaste perception.

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