



APPLICATION OF THE ANALYTICAL HIERARCHY PROCESS (AHP) FOR PACKAGING SELECTION OF THE BALINESE FOOD “LEDOK”

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ABSTRACT

One of the local food that is currently consumed and developed in Bali is Ledok. Ledok is a non rice food with main ingredients of corn, cassava, red beans and peanuts are boiled and added green vegetables, and spices. Today Ledok has been developed into Ledok instant. This product is popular because it meets local tastes, practical, and has a long shelf life of six months. Instant ledok needs to be commercialized into a typical Bali local food product that is able to compete with other non-rice products already available in the market. In this study the selection of the bucket packaging was chosen to increase the added value and commercialization of the product. The method used to determine the packaging priority used for Ledok instant is Analytical Hierarchy Process. Criteria used in the selection of packaging types are raw materials, price, strength, flexibility, appearance, environmentally friendly. Alternatives of this type of packaging are the types of packaging commonly used for food products such as paper, plastic, aluminum foil, paper and plastic combination, aluminum foil and plastic, cans, styrofoam and glass. The global priority for this type of packaging is a plastic-paper combination with a value of 1,360. The agreed criteria for packaging form are practicality, strength, price, and appearance. The alternatives chosen for the packaging form are pouch, bag, round, box, bottle, and bowl. The global priority for packaging is the pouch, with a score of 1,671. The appropriate type and form of packaging for Ledok Instant as a local Balinese food has never been studied before. So the findings of this research can increase the added value of developed Ledok instant

Key Words: Balinese food, Instant Ledok, AHP, type and form of packaging

Introduction

Traditional cuisine is one of the unique culture in Bali, which is currently being developed by the government to be preserved. Ledok is an alternative food sourced from tubers, maize, beans and green vegetables, which is consumed by the community in Nusa Penida Sub-district Klungkung regency of Bali Province. Currently Ledok has been incorporated into one of the local wisdom in Bali. Ledok developed by the government of Klungkung Regency Bali Province as an effort to preserve the positive tradition that has been rooted in the community and as a form of utilization of local non-rice food-based resources that are easily obtained by the community .

Further development of Ledok is done on the processing and presentation that is developed into Ledok instant. According to Wijaya et al. (2014) [1], the shelf life of instant Ledok is 6 months. Characteristics of isothermic sorption of water Ledok instant is a type II sigmoid shaped. The Ledok instantaneous process is done by pressure cooking, freezing and drying method. According to Wrsiati et al (2014) [2], the process does not reduce the macro nutrient content (nutrient macro) in Ledok. The results showed that the best process at Ledok instant processing was pressure cooking for 12 minutes, 72 hours freezer and 24 hour drying. This process produces instant Ledok with 2.9% water content, 11.81% protein, 10.09% fat, 0.02% ash, crude fiber 14.13%, and 63.76% carbohydrate. One instant bite serving is 80 grams with a calorie content of 400 calories.

Innovation and creation of local food products is necessary so that it is not consumed by local people but becomes food available in the broad market. Good quality control, attractive shapes and colors, distinctive names, practical presentation, and popular packaging usage, labeling that meets the requirements of food products can attract consumers to buy local food products. Today in some countries such as Japan, Korea and Thailand are packing their traditional foods with attractive packaging (eye-catching) so worthy of being souvenired by tourists. Determining the product packaging to be marketed must consider and can present several factors, namely safety factor, economic factor, distribution factor, communication factor, ergonomic factor, aesthetic factor, identity factor, promotion factor, and environmental factor. Food packaging is an essential part of modern society. Commercially processed food and fresh food are handled and distributed safely and efficiently using appropriate packaging (Shin and Selke, 2014) [3]

Today there are many types of food packaging on the market, there are natural packaging such as from plants, animal skins, and soil, synthetic packaging of plastics, glass, alufo, and cans or packs of combination of natural and synthetic like combination of paper with plastic or wood With glass. Besides the types of packaging that are commonly found in the market, today also developed a new type of packaging called biobased polymer that is packaging material sourced from plants, animals, marine life, or microorganisms, also called natural packaging (Van Tuill et al., 2000)[4]. Some companies decide to use packaging that is environmentally friendly, recyclable or reusable to deliver more value to the product being sold. Environmentally friendly packaging trends have proven to be more attractive to consumers to buy products even though product prices become more expensive. According to Calder and DuPuis (2010)[5], packaging design has become a part of brand design and marketing strategy, and consumer communication.

Ledok traditional marketed today is Ledok ready for consumption. Its marketing has begun to flourish and is available at culinary festivals organized by the government. Ledok instant has also been introduced in several culinary festivals in Bali. Instant Soap products do not yet have the appropriate packaging to market. The availability of many types and forms of food packaging on the market, causing problems in decision making the use of packaging for Ledok Instan. In this research, the analysis of decision making in the selection of priority types and packaging forms using Analytical Hierarchy Process (AHP) method. Ledok traditional marketed today is Ledok ready for consumption. Its marketing has begun to flourish and is available at culinary festivals organized by the government. Ledok instant has also been introduced in several culinary festivals in Bali. Instant Soap products do not yet have the appropriate packaging to market. The availability of many types and forms of food packaging on the market, causing problems in decision making the use of packaging for Ledok Instan. In this research, the analysis of decision making in the selection of priority types and packaging forms using Analytical Hierarchy Process (AHP) method. Some of the AHP applications are evaluation of technology investment decisions (Boucher and McStarvic, 1991) [6], energy efficient facility layout design (Yang and Deuse, 2012)[7], contractor selection (Balubaid and Alamodi, 2015)[8], selection of traditional snackfood and selection of engineering education.

Method

The first step of the AHP method is to define criteria and alternatives and to compile a hierarchical chart. The selection of criteria for the type and form of Instant Ledok packaging begins with a survey of 50 respondents who have already consumed traditional Ledok and Ledok instant, and have sufficient knowledge about the type and form of instant food packaging. Criteria specified for packaging type are raw material, price, strength, flexibility, Appearance, Environmentally friendly. Alternative types of packaging are paper, plastic, paper-plastic, aluminum foil, plastic-alufo, glass, cans, and styrofoam. The criteria specified for the packaging form are ergonomic, strength, Price, and Appearance. The alternatives for packaging are pouch, round, bag, boxes, bottle, and bowl. Hierarchical charts are arranged in order of purpose, criteria and alternatives as in Figure 1.

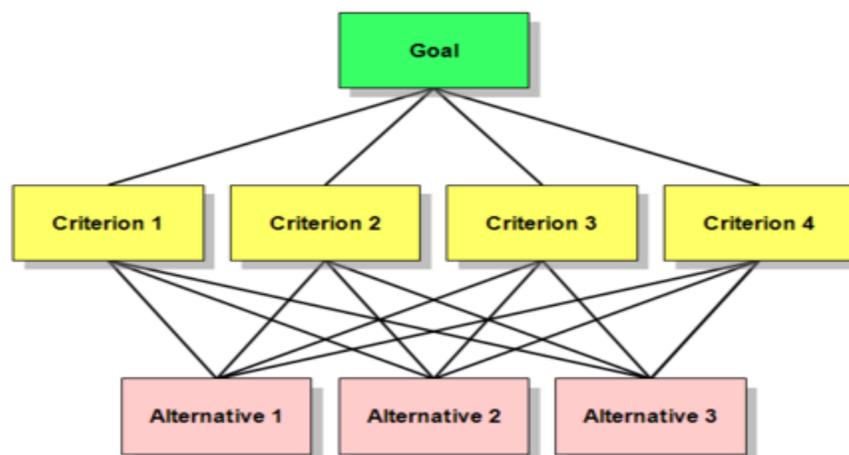


Figure 1. AHP Chart (Saaty, 1980) [9]

The second step is to provide a value based on the comparison of interests set out in table 1 below. This assessment was conducted by three experts namely traditional food processing experts, packaging experts, and researchers in the field of decision analysis. Decision-making to obtain one comparative score is done through Focus Group Discussion (FGD). The AHP generates a weight for each evaluation criterion according to the decision maker's pairwise comparisons of the criteria. The higher the weight, the more important the corresponding criterion. The AHP assigns a score to each option according to the decision maker's pairwise comparisons of the options based on that criterion. The higher the score, the better the performance of the option with respect to the considered criterion.

Table 1. The AHP Scale

The fundamental scale for pairwise comparisons		
Intensity of importance	Definition	Explanation
1	Equal importance	Two elements contribute equally to the objective
3	Moderate importance	Experience and judgment slightly favor one element over another
5	Strong importance	Experience and judgment strongly favor one element over another
7	Very strong importance	One element is favored very strongly over another; its dominance is demonstrated in practice
9	Extreme importance	The evidence favoring one element over another is of the highest possible order of affirmation
Intensities of 2,4,6, and 8 can be used to express intermediate values. Intensities 1.1, 1.2, 1.3, etc. Can be used for element that are very close in importance.		

The third step is setting priorities for each criterion and alternative. An approach based on pairwise comparisons which was proposed by Saaty (1980) [9] has long attracted the interest of many researchers. It is used to determine the relative importance of each alternative in terms of each criterion. The decision-maker has to express his / her opinion about the value of one single pairwise comparison. According to the scale on Table 1, the available values for the pairwise comparisons are members of the set: 9, 8, 7, 6, 5, 4, 3, 2, 1, 1/2, 1/3, 1/4, 1/5, 1/6, 1/7, 1/8, 1/9. If an alternative a is compared to itself, it is given a value of one. If alternative a is compared with alternative b will get a certain value eg 3, then if alternative b compared with a will get the opposite value is 1/3. The results of this assessment are made in matrix form.

The fifth step is the determination of logical consistency with the following steps:

- A. Multiplies matrix with corresponding priority.
- B. Sums up the results per line.
- C. The sum of each line is divided by the relevant priority and the results are summed.
- D. The result of c divided by the number of elements, will be obtained λ_{maks} .

E. Consistency Index (CI) = $(\lambda_{maks}-n) / (n-1)$

F. Consistency Ratio = CI / RI, where RI is a random consistency index. If the consistency ratio ≤ 0.1 , the calculation results can be justified. The list of RI is presented in table 2. If the consistency ratio is greater than 0.1 then re-checking or reassessment of the comparison value in matrix pairs is done until the consistency ratio is obtained ≤ 0.1 .

Table 2. Random Consistency Index Value

Matri x Size	1,2	3	4	5	6	7	8	9	10	11	12	13	14	15
RI value	0,0 0	0,5 8	0,9 0	1,1 2	1,2 4	1,3 2	1,4 1	1,4 5	1,4 9	1,5 1	1,4 8	1,5 6	1,5 7	1,5 9

Results and Discussion

Instant Ledok Packaging Type

Criteria used in selecting the type of packaging is raw materials, price, strength, flexibility, appearance, environmentally friendly. Alternatives of this type of packaging are paper, plastic, aluminum foil, combination paper and plastic, aluminum foil and plastic, cans, styrofoam and glass. The type of packaging according to Shin and Selke (2014)[3] is a type of packaging that is commonly used for food. The selection of Ledok Instan packing type criteria was conducted with questionnaire and continued with discussion with the experts (Focus Group Discussion). The hierarchical diagram for the type of packaging is presented in Figure 2.

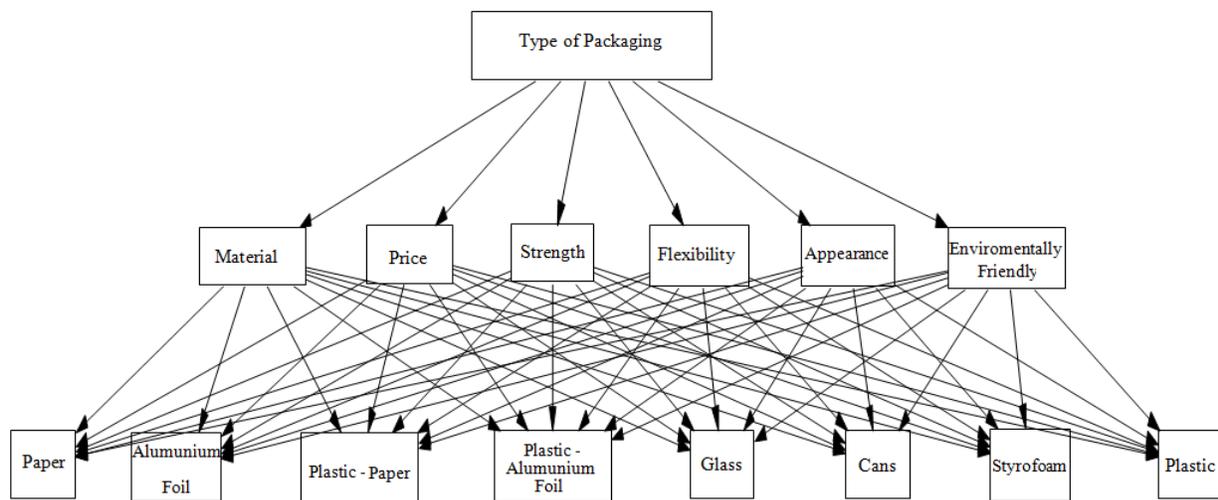


Figure 2. Hierarchy for packaging type

After calculation following 4 steps calculation of AHP, obtained by decision of selection of priority type of packing of Instant Ledok as presented in Table 3. Based on AHP calculation in the table, for raw material criterion, the selected packaging priority is plastic-paper, the selected price criterion is Plastic because plastic packaging has the cheapest price, the selected strength criterion is glass packaging, plasticity chosen is plastic, the selected appearance is plastic-paper, and the environmentally friendly is selected paper. The global priority for this type of packaging is a plastic-paper combination with a global priority value of 1.36. The decision to choose the type of plastic-paper combination packaging in accordance with the statement of Marsh and Bugusu (2007) [10] which states that paper can be laminated with polyethylene to make it heat sealable and to improve gas and moisture barrier properties. However, lamination substantially increases the cost of paper. Laminated paper with plastic is used to package dried products such as soups, herbs, and spices.

Table 3. Calculation results of AHP packaging type

Alternative	Criteria						Global Priority
	Raw Materials	Price	Strengths	Flexibility	Appearance	Environmentally Friendly	
Plastic	0,149	0,289	0,083	0,296	0,116	0,196	1,129
Paper	0,209	0,213	0,056	0,173	0,221	0,321	1,193
Alufo	0,075	0,075	0,054	0,080	0,045	0,048	0,378
Plastic-paper	0,342	0,201	0,184	0,170	0,306	0,156	1,360
Plastic-alufo	0,103	0,104	0,103	0,166	0,064	0,058	0,597
Glass	0,059	0,058	0,296	0,026	0,115	0,105	0,658
Cans	0,037	0,036	0,203	0,052	0,080	0,091	0,499
Sterofoam	0,025	0,025	0,022	0,036	0,052	0,026	0,186

Instant Ledok Packaging Form

The criteria used for packaging form are practicality, strength, price, and appearance. The alternatives are pouch, bag, round, box, bottle, and bowl. Shapes in packaging design is one of the most important influencing factors in consumers' behavior and preferences. The shapes of packaging have a direct impact on the consumer perception (Dadras, 2015)[11]. Attractive food packaging can affect consumers' attention to purchase the product. Figure 3 is a hierarchical diagram for the packaging form.

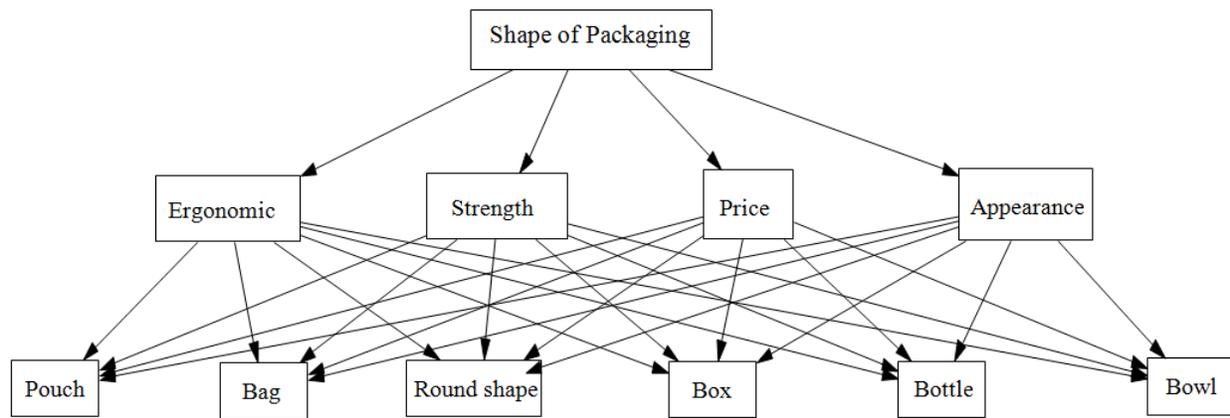


Figure 3. Hierarchy of packaging form

After calculation following 4 steps calculation of AHP obtained that decision of priority selection form of packing of Instant Ledok as presented in Table 4. Based on AHP calculation in the table, for the criteria of practicality, the priority of the selected packaging form is pouch, and on the selected strength criterion is the pouch, The selected price criteria is pouch packaging, the selected performance criteria is the pouch. The global priority for the packaging form is the pouch with the global priority value of 1,671. According to research Vyas (2015)[12], Shape of the packaging was associated with consumer response as well as attracted to the product and deliver brand value. Size and shape of the package have been related to the benefits of drawing, and finding it in the store.

Table 4. Results of AHP Calculation for Packaging Form

Alternative	Criteria				Global priority
	Practicality	Strength	Price	Appearance	
Box	0,280	0,112	0,056	0,132	0,580
Round	0,057	0,037	0,074	0,039	0,206
Bag	0,063	0,120	0,206	0,231	0,620
Pouch	0,405	0,423	0,400	0,444	1,671
Bottle	0,063	0,169	0,160	0,095	0,487
Bowl	0,133	0,140	0,104	0,060	0,436

Conclusion

The criteria used in selecting Ledok Instan packaging type are raw material, price, strength, flexibility, appearance, environmentally friendly. Alternatives of this type of packaging are paper, plastic, aluminum foil, combination paper and plastic, aluminum foil and plastic, cans, styrofoam and glass. The global priority for the Instant Ledok packaging type is a plastic-paper combination with a global priority value of 1.36.

The criteria used for the Instant Ledok packaging form are practicality, strength, price, and appearance. The alternatives are pouch, bag, round, box, bottle, and bowl. The global priority for Instant Ledok packaging is a pouch with a global priority value of 1,671.

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