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Innovation of Goat's Milk Soft Candy with Annatto Extract (*bixa orellana* l.) As Natural Colorant and Antioxidant

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***Abstract*— The research aims to produce innovative soft candy from goat's milk and annatto extract as colorants and antioxidants that consumers like. Soft candy product innovations were studied in random group designs consisting of five concentrations of annatto extract (0%, 0.15%, 0.20%, 0.25%, and 0.30%). The results showed that the addition of annatto extract in the goat's milk soft candy formula decreases the L value, along with an increase of a* and b values so that the color of the soft candy becomes orange. Increasing the concentration of annatto extract causes a significant increase in antioxidant activity. The addition of annatto extract in the goat's milk candy formulation influenced the level of preference for the color attribute but did not affect the aroma, taste, and texture attributes. The goat's milk soft candy with the addition of 30% annatto extract as a natural colorant and antioxidant produced the best physicochemical and sensory characteristics based on index effectivity value. This soft candy resulted in a water content of 7.46±0.74%, ash content of 0.57±0.07%, and antioxidant activity of 69.20±1.07%. The addition of annatto extract also does not affect the ash content or water content of the goat's milk soft candy produced.**

***Keywords*— annatto, antioxidant; goat's milk; natural dyeing; soft-candy**

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I. INTRODUCTION

Goat's milk is one source of milk that contains more short and medium chain fatty acids (medium chain triglycerides), which have unique metabolic capabilities to provide energy for growing children and are used to treat patients with malabsorption [1]. The presence of medium chain fatty acids such as caprylic, capric, and caproic acids in goat's milk is useful in helping reduce cholesterol and increase mobility in tissues. Goat's milk contains high levels of essential fatty acids in the form of arachidonic acid, linoleic acid, and conjugated linoleic acid and contains around 0.2-0.5% lactose, so it is lower than cow's milk [2]. The low lactose content in goat's milk has the potential to reduce allergy rates [3]. Goat's milk has an important role in human nutrition [4] because it causes less allergies and has higher nutritional value and digestibility of milk compounds than cow's milk [5].

The fatty acid profile of milk fat can influence dairy products' nutrition and market value. This is interesting if it is related to the role of lipids, which are considered very important where the biologically active components of goat's milk have high nutritional value so that they have the potential to influence the physicochemical, sensory properties and profile of the product diversification. One of the innovations in processed goat milk products is milk candy.

Candy is a type of confectionery that is popular because it is easy to consume and carry and produces a comfortable feeling after chewing it. With technological developments, candy is made from various ingredients, producing colors, tastes textures, and functional properties according to consumer

desires. Based on chewing power, there are two types of candy: hard candy and soft candy. Milk candy is a type of soft candy that is widely available on the market because all groups like it [6]. The soft texture of soft candy so that it is easy to consume is one of the requirements consumers want when chewing milk candy [7]. The color variations of milk candy have experienced rapid development, including the development of research into candy with natural dyes [8]. This is thought to be due to the carotenoid content of annatto so that the color of the candy becomes more orange [9]. Likewise, combining milk ingredients and natural candy coloring that produce functional antioxidant properties is interesting for further study. Innovations in the formulation of goat's milk and natural annatto extract coloring are thought to influence the physicochemical characteristics, especially antioxidants, the color produced by carotenoids and sensory attributes such as taste, aroma, and texture [10].

Adding color to food products, including candy, has been proven to have a significant influence on consumer perceptions regarding food acceptability [11]. One potential natural colorant is annatto extract which is produced from Annatto (Bixa orellana L.) seeds. Annatto seeds (Bixa orellana L.) contain 80% bixin and 20% morbixin as an antioxidant against free radicals and are useful as a safe, natural colorant [12]. The chemical structure of bixin and norbixin, which consist of nine conjugated double bonds, causes them to produce an orange-to-red color [12,13]. Bixin and norbixin are carotenoid compounds that can be extracted from Annatto seeds, a plant that lives easily in hot climates [12]. Bixin in the food industry is usually formulated to display colors in the range of orange, yellow, orange, and red in various fat-based foods (cheese, butter, margarine, yoghurt, cream) and snacks (cakes, biscuits). Bixin can be used as a coloring agent for cooking oil, corn oil, and salads. The norbixin compound can be used as an orange to yellow color enhancer in rice flour, corn flour, soy sauce, tomato sauce, syrup drinks, fruit jams, and sweets [12,13]. A natural coloring, annatto has been proven to be safe for health and can provide additional beneficial functional properties to the food products to which it is added [12]. This research aims to produce innovations in soft candy made from goat's milk with annatto extract as antioxidants that consumers like. The benefits of the innovation from goat's milk with annatto soft candy as colorants and antioxidants are one of the choices for functional candy as well as providing candy ingredients for people with lactose intolerance. Developing functional candy increases the market's revenue and enables the confectionery market to develop a new candy type.

II. MATERIAL AND METHODS

A. Material

Research material consists of fresh goat milk obtained from Tazayyad Farm Pontianak, Indonesia, dried annatto seeds, granulated sugar merk Rose Brand Premium), glucose syrup Brix 75, brand of Sweetfood Supply, gelatin brand of Hakiki, agar powder brand of Swallow Globe Brand, Whatman filter paper Number 1, DPPH (1,1-diphenyl-2-picry hydrazil) was obtained from HiMedia (India), ethanol (Analytical Reagent, 99.9%) and methanol (analytical reagent, 99.9%) was obtained from SMART-LAB, Tangerang Indonesia.

The tools used in this research are desiccator, oven (Philip Harris Ltd), baking sheet, UV-VIS spectrophotometer (Shimadzu UV mini-1240), colorimeter AMT506, erlenmeyer (IWAKICTE33), aluminum foil, beaker glass (IWAKICTE33), porcelain cup, centrifuge, magnetic stirrer, hot plate, vacuum filtration (ROCKER300-JOANLAB), vortex, micropipette (Socorex Swiss), thermometer, analytical balance (Mettler Toledo), Whatman no.1 filter paper, test tube clamp, container, stir bar and candy mold.

B. Methods

Research design of oft candy product innovations were studied in random groups using a variety of annatto extract supplementation in goat's milk soft candy formula, with 5 levels, namely formula I: 0%, II: 0.15%, III: 0.20%, IV:0.25% and V:0.30% with five replications. The research stages include making bixin extract from Annatto seeds, formulating goat sisu soft candy and annatto extract as a coloring and antioxidant, testing the quality of soft candy, and data analysis.

Preparation of annatto extract

Annatto extraction from annatto seeds refers to the research of [14]. At room temperature, 50 g of annatto seeds was macerated with 150 mL of ethanol solvent for one day using a magnetic stirrer. The extraction process was repeated three times. The extraction results are concentrated using a rotary evaporator at a temperature of 40℃. The thick filtrate produced is annatto extract.

Goat milk soft candy formulation with annatto extract as coloring and antioxidant

The formulation of soft candy from goat's milk and annatto extract as coloring and antioxidants refers to [15]. 100 g of goat's milk and 75 g of granulated sugar are mixed, then heated until the granulated sugar is dissolved, 5 g of gelatin, 25 g of glucose syrup, and 3 g of agar powder are added, then stirred until homogeneous, and then the heating of the mixture is increased to a temperature of 95℃. After the mixture thickens, the temperature is lowered to 60℃, then annatto extract is added according to the formulation in **Table 1**. accompanied by stirring until it is homogeneous in the mixture, then molded, followed by cooling the candy at room temperature for 4 hours, followed by cooling in a cooling cupboard until goat's milk soft candy is formed.

TABLE 1.
SOFT CANDY FORMULATION FROM GOAT MILK AND ANNATTO EXTRACT AS COLORANT AND ANTIOXIDANT

Material (g)	Addition of Annatto Extract in Goat's Milk Candy Formulation *				
	I (0 %)	II (0.15 %)	III (0.20 %)	IV0.25 %)	V (0.30 %)
Goat milk	100	100	100	100	100
Sugar	75	75	75	75	75
Glucose syrup	25	25	25	25	25
Gelatin	5	5	5	5	5
Agar-agar	3	3	3	3	3
Annatto extract	0	0.312	0.416	0.52	0.624
Total	208	208.312	208.416	208.352	208.624

* The addition of annatto extract is calculated towards the total percent of ingredients without annatto

Characterization of The Quality of Goat Milk Soft Candy with Annatto Extract as A Coloring and Antioxidant

The quality of soft candy made from goat's milk with annatto extract as a coloring and antioxidant is determined based on physical, chemical, and sensory characteristics. Physicochemical characteristics include color analysis based on the International Commission on Illumination (CIE) system, where L* is for lightness, a* for red or green, and b* for yellow or blue [16]. Water content is based on gravimetric analysis based on wet weight [17], ash content using the dry ashing method [18], and antioxidant activity using spectrophotometry [19]. Antioxidant activity was analyzed based on the percentage of DPPH free radical scavenging ability spectrophotometrically. 100 mg soft candy from goat's milk and bixin extract, dissolved in 99.9% methanol to reach a volume of 5 ml. The sample was vortexed until dissolved and then centrifuged for 15 minutes using a rotation speed of 3000 rpm. 0.5 mL of sample was placed in a test tube plus 3.5 mL of DPPH solution at a concentration of 0.1 mM, followed by incubation for 30 minutes. The sample was stamped at ƛ 517 nm with a methanol blank. Organoleptic quality is determined by a hedonic test using four sensory attributes in the form of color, aroma, taste, and texture, followed by the Kruskal Wallis test.

Data analysis

The observational Physicochemical characteristics data was analyzed by Analysis of Variance (ANOVA), and if the results showed significant differences, it was continued with post hoc Tukey test using of $\alpha \leq 5\%$. Sensory characteristics based on the hedonic test are analyzed using Kruskal-Wallis. The best treatment value was obtained by the effectiveness index [20]. The value of the observation variables for testing the effectiveness index values is presented in **Table 2**.

TABLE 2.
RESEARCH VARIABLE VALUE

Variable	Value
L (lightness)	1
a* (red to green)	1
b* (yellow to blue	1
Antioxidant	1
Water content	0.9
Sensory Attributes of Color	0.9
Sensory Attributes Ash Content	0.8
Aroma Sensory Attributes	0.8
Sensory Attributes of Taste	0.8
Textural Sensory Attributes	0.8

III. RESULT AND DISCUSSION

Please take note of the following items when proofreading spelling and grammar:

A. Quality of Soft Candy from Goat's Milk with Annatto Extract as a Colorant

Color is an element that determines the level of consumer acceptance of a product. The results of observing the color characteristics of soft candy made from goat milk with bixin extract as colorants are presented in **Fig. 1**. **Fig. 1** shows that the addition of annatto extract to soft candy causes a reddish orange color. This is due to the content of bixin and norbixin compounds in annatto extract.

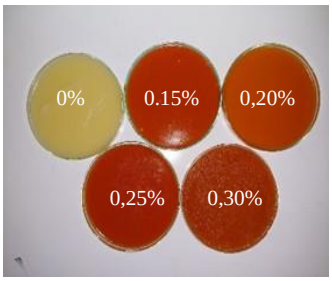

Fig. 1 Soft Candy from Goat's Milk with concentration variation of Annatto Extract

The color of goat's milk candy was determined using the CIElab system using three color dimensions, namely L, a*, and b*. The L value indicates the brightness level on a scale of 0 (indicating black or dark) to a scale of 100 (indicating bright or light). The a* value indicates the level of redness or greenness, the value +60 is red, the value -60 is green. The b* value indicates the level of yellowness or bluishness, the value +60 is yellow, the value is -60 blue. Table 3 presented the color characteristics of soft candy from goat milk and annatto extract as colorant. The results of observing the color characteristics of soft candy from goat milk and bixin extract as colorants presented in **Table 3**.

TABLE 3.
COLOR CHARACTERISTICS OF SOFT CANDY FROM GOAT MILK WITH ANNATTO EXTRACT AS COLORANT

Addition of Annatto Extract in Goat's Milk Candy Formulation (%)	L	a*	b*
0	41.0±3.06^{b}	-3.92±0.46^{a}	3.67±0.95^{a}
0.15	34.5±2.09^{ab}	9.08±0.52^{b}	9.46±0.80^{b}
0.20	31.9±2.30^{a}	10.72±0.65^{bc}	11.13±0.79^{b}
0.25	30.8±2.05^{a}	11.26±0.84^{cd}	11.92±0.84^{b}
0.30	29.3±1.10^{a}	12.63±0.80^{d}	14.05±0.94^{b}
Tukey 5%	7.389	1.695	2.277

The highest L value (41.0) was obtained in the soft candy that is produced by the goat's milk with 0% annatto formulation and the lowest value (29.3) was in the soft candy that is produced by the goat's milk with 0.30% annatto formulation. The higher the concentration of annatto extract in the formulation, the more the soft goat's milk candy brightness will decrease. The results of this research are supported by other research regarding lemon peel jelly candy, which revealed that the decrease in the brightness level of soft candy could be caused by the presence of carotenoid content as a colorant. High levels of carotenoids will reduce the lightness level, or the color will become darker [21].

The a* value for soft candy from goat's milk with annatto extract ranges from 9.08 to 12.63, which tends to be red, while goat's milk soft candy without annatto extract produces a negative value, namely -3.92, which tends to be white. The b* value for soft candy from goat's milk with annatto extract has a positive value ranging from 9.46-14.053, indicating that it tends to be yellow but the result showed not significantly different by Tukey test. This happens because annatto extract contains of 80% bixin which produces a red-orange color [12, 13, 22] that orange colour dominantly. **Table 3** shows that increasing the concentration of annatto extract in the goat's milk soft candy formula decreases the L value and increases the a* and b values. The results of other research regarding the application of annatto extract from Annattoa as a source of natural coloring and antioxidants in "cassava getuks", showed that increasing the concentration of the extract added to cassava getuks resulted in increased color intensity. This is because the greater the amount of colorant added to the product, the resulting color intensity increases [23].

B. Chemical Quality of Soft Candy from Goat's Milk with Annatto Extract as a Colorant and Antioxidant

The chemical quality of soft candy is formulated from goat's milk with annatto extract as a natural coloring and antioxidant based on test results for water content, ash content and antioxidant activity (**Table 4**).

TABLE 4.
CHEMICAL QUALITY CHARACTERISTICS OF SOFT CANDY FROM GOAT'S MILK WITH ANNATTO EXTRACT

Addition of Annatto Extract in Goat's Milk Candy Formulation *	Water content (%)	Ash content (%)	Antioxidant Activity (%)
0	7.91±0.95	0.51±0.04	34.16±1.14^{a**}
0.15	7.51±1.04	0.50±0.03	48.34±1.39^{b}
0.20	7.30±1.06	0.48±0.04	60.52±1.47^{bc}
0.25	7.35±1.10	0.54±0.05	63.08±1.80^{cd}
0.30	7.46±0.74	0.57±0.07	69.20±1.07^{d}
Tukey 5 %			3.1450

Note: * the addition of annatto extract is calculated towards the total percent of ingredients without annatto extract
** Different letters indicate a significant difference of P≤0.05 in Tukey test

Based on **Table 4**, the water content of goat's milk soft candy did not affected by the supplementation of annatto extract. The range of water content of soft candy made from goat's milk with annatto extract is 7.30 to 7.91%. The manufacturing process influenced the water content of soft candy from goat's milk with annatto extract as a colorant and antioxidant. Making soft candy involves the process of heating the dough to 95°C, which is thought to evaporate the free water from the mixed ingredients and the water remaining is the result of trapping the mass of the ingredients due to the hydrocolloid content, namely gelatin and agar-agar. Gelatin and agar-agar are hydrocolloids that bind water in soft candy [24]. The results of other research showeds that ginger extract added to soft candy did not affect water content. It is suspected that the water content in soft candy is influenced by sugar and hydrocolloid compounds [25,26].

The role of hydrocolloid gelatin and agar in the process of soft candy from goat's milk with annatto extract is very large in producing water content, but in this study because it was not a treatment, the effect was not significant. Gelatin is a water-soluble, high molecular-weight polypeptide derived from the partial hydrolysis of collagen that has a triple helix structure [27]. Confectionery gels, including soft candy, in formulations, consist of high sugar components, such as sucrose and glucose syrup, and are combined with gelling agents, food acids, flavors, and colorings [28]. Gelatin's firm, elastic nature makes it a desired gelling agent in many products, including soft candy made from goat's milk with annatto extract at concentrations above 5 % [29]. Incorporating hydrocolloids, such as agar-agar, into the gelatin gummy showed a synergistic effect on the gel network due to the nature of hydrocolloids and the ratio to gelatin in the formulation, and in this research the formulation of goat's milk soft candy was used 5% gelatin and 3% agar-agar of total ingredients. The gelatin chains exist in flexible random

coil conformation above the gelling temperature. During the gelling, the chains experience conformational transitions and partly regenerate the collagen triple helix structure. The triple helices link together to form the thermos reversible network [30]. Many gelling agent products on the market today are composite gels, containing two or more gelling agents, which impart specific flow behaviors, textures, appearances, and sensory properties to products [28]. Previous research also supports that the effect of a combination of gelling agents such as agar-agar, into the gelatin gel could affect its gelatin network at intramolecular and intermolecular levels [31].

Based on **Table 4**, the ash content of soft candy from goat's milk with annatto extract ranges from 0.48-0.57%. revised the sentence. The concentration of annatto extract added to the formula does not affect the ash content of the soft candy produced from the goat's milk. The soft ash content produced by the research is thought to have come from the annatto and hydrochloric acid extracts used. The ash content of bixin derived from Annatto seeds is 6.2% [32]. The minerals in annatto seeds showing the highest values are sodium (35.61 mg.g–1) and potassium (70.77 mg.g–1), followed by manganese (0.25 mg.g–1), calcium (0.11 mg.g–1) and copper, iron, and magnesium (0.03 mg.g–1) [33]. The results of the same research with no significant effect were also obtained by [34] regarding Moringa leaf goat's milk candy stated that the ash content produced was between 0.7588-0.7772%. The highest value was obtained from the addition of 20% Moringa leaf extract, amounting to 0.7772%.

The results of the antioxidant activity test of soft candy from goat's milk with annatto extract as a coloring and antioxidant (**Table 4**) show a significant difference at $\alpha \leq 5\%$ of ANOVA. The lowest antioxidant activity was found at a concentration of 0%, namely 34.16%, and the highest antioxidant activity value was found in goat's milk soft candy with the addition of 0.30% annatto extract with a value of 69.52%. The higher the concentration of annatto extracts added, the antioxidant activity of goat's milk soft candy increases. Bixin and norbixin, which can be extracted from annatto seeds, are both carotenoids. The composition consists of 83.41 ± 4.54% bixin ($C_{25}H_{30}O_4$) and 19.19 ± 1.56% norbixin ($C_{24}H_{28}O_4$) [12, 13, 23]. Carotenoids, as antioxidants, play a role in neutralizing free radicals by donating hydrogen atoms so that the molecules become stable [35]. Adding carrot extract and kiwi juice to soft candy can increase antioxidant activity [36]. The highest antioxidant activity was possessed by soft candy with the addition of the most extracts. The extract concentration influences antioxidant activity.

C. Sensory characteristics of Soft Candy from Goat's Milk with Annatto Extract as a Colorant and Antioxidant

The results of the Kruskal Wallis (KW) analysis showed that supplementation of annatto extract in the formula had a significant effect on color but had no significant effect on the aroma, taste and texture of soft candy from goat's milk with annatto extract. The sensory values of soft candy from goat's milk with annatto extract as a colorant and antioxidant are presented in **Table 5**.

TABLE 5.
SENSORY CHARACTERISTICS OF SOFT CANDY FROM GOAT'S MILK WITH ANNATTO EXTRACT AS A COLORANT AND ANTIOXIDANT

Addition of Annatto Extract in Goat's Milk Candy Formulation (%)	**Mean ±sd**			
	Color	**Aroma**	**Taste**	**Texture**
0	3.04±0.75	3.48±0.70	4.00±0.57	3.90±0.60
0.15	3.78±0.60	3.48±0.74	3.80±0.86	3.48±0.74
0.20	3.86±0.58	3.50±0.72	3.48±0.82	3.50±0.61
0.25	4.02±0.44	3.52±0.67	3.60±1.04	3.60±0.93
0.30	4.16±0.47	3.58±0.77	3.32±0.85	3.64±0.92
Chi^2=9.488 KW	17.42	1.58	8.96	4.14

The results of the sensory test (**Table 5**) show that the concentration of annatto influences the preference value for goat's milk soft candy extract supplementation in the milk soft candy formula. The highest color preference value was found in soft candy from goat's milk with 0.30% annatto extract supplementation, which is 4.16, and the lowest was in goat's milk soft candy without adding annatto extract (0%), which is 3.04. The research results showed that the innovation of goat's milk soft candy with 0.30% annatto extract supplementation coloring was produced based on the effectiveness index. However, in general it appears that soft candy from goat's milk with annatto extract is thought to be because goat's milk ingredients produce a distribution of short chain fatty acids so that the globules show smaller granules and a smoother texture. Color is one of the most important attributes of food products. Color is the key to increasing the taste value and consumer acceptance of food and drinks [37]. The orange color that appears in goat's milk soft candy is due to the carotenoid content in the form of bixin in the seed membrane which gives it a red-orange color [22]. Research by [38], showed that the addition of lemongrass extract and tomato extract affected on the color of the soft candy produced. That research revealed that the carotenoid content in tomatoes affected on the color of the soft candy. Carotenoids are compounds consisting of isoprene and its derivatives with yellow, orange, and red-orange color groups. Supplementation of annatto extract in the goat's milk soft candy formula as a natural coloring for goat's milk soft candy can increase the level of preference for the color of goat's milk soft candy.

The highest taste preference value was found in goat's milk soft candy without the addition of 0% annatto extract resulting in a value of 4.00 (prefer) and the lowest value was in goat's milk soft candy with the addition of 0.30% annatto extract, namely 3.32 (like). According to another study, the taste of a food product is influenced by the raw materials and their interactions with other components [38]. The taste produced from goat's milk soft candy with the addition of 0% concentration of annatto extract tends to have a sweet taste, however, goat's milk soft candy with 0.15 to 0.30% annatto extract supplementation

has a bitter taste, presumably because the panelist senses have felt the annatto content so it is preferred. consumer. It is suspected that the taste comes from annatto seed extract, which is known to contain phytochemical compounds. Bixa orellana L. is a plant with good phytochemical content [39]. In their research, the ethanol extract of annatto seeds contained tannins, terpenoids, alkaloids, and glycosides, while the water extract of annatto seeds contained tannins, flavonoids, terpenoids, glycosides, and phenols. Quantitatively, the tannin contained in Annatto seeds is 44.79, flavonoids are 8.86, glycosides are 93.33 and phenols are 82.99. The bitter taste of the extract is caused by the presence of alkaloids, tannins, glycosides, and saponins [40]. Saponins in plants taste bitter but also have cooling properties [41].

The highest texture preference value was found in goat's milk soft candy without adding 0% annatto extract, which produced a value of 3.92; the lowest was in goat's milk soft candy with the addition of 0.20 and 0.25% annatto extract, namely 3.48. The results of Kruskal Wallis' analysis showed that annatto extract supplementation had no significant effect on the texture of goat's milk soft candy. Gelatin influences the texture of the soft candy produced [38]. Meanwhile, in this study, the concentration of gelatin used was the same. The soft texture of goat's milk soft candy is influenced by the short and medium fatty acid content of goat's milk. However, the amount in the formula is the same, while annatto extract does not contain these fatty acids.

D. Index effectiveness of Soft Candy from Goat's Milk with Annatto Extract as a Colorant and Antioxidant

The effectiveness index method is determined by weighting each variable based on standards and level of importance. The resulting value weights (**Table 2**). Then it is used to calculate the highest Treatment Value (TV), the results are presented in **Table 6**.

TABLE 6.
INDEX EFFECTIVENESS OF SOFT CANDY FROM GOAT'S MILK WITH ANNATO EXTRACT AS A COLORANT AND ANTIOXIDANT

Addition of Annatto Extract in Goat's Milk Candy Formulation (%)	**TV**
0	0.53
0.15	0.47
0.20	0.59
0.25	0.54
0.30	**0.63**

* Description (bold value) is the best formula

The results of the effectiveness index test show that goat's milk soft candy with the addition of 0.30% annatto extract produces the highest treatment value (TV), namely 0.61, which produces a water content of 11.46%, an ash content of 0.66%, an antioxidant activity value of 26 .10%, as well as a color sensory value of 3.96, an aroma sensory value of 3.85, a taste sensory value of 3.32 and a texture sensory value of 3.60. This is because the concentration of 0.30% addition of annatto seed extract has the highest NP compared to the others. The best treatment has the highest value [20].

IV. CONCLUSION

The research results showed that the addition of annatto extract in the goat's milk soft candy formula decreases the L value, along with an increase in the a* and b values, and the color of the soft candy to become orange because annatto extracts contain carotenoids. Increasing the concentration of added annatto extract in the goat's milk candy formulation causes a significant increase in antioxidant activity. The addition of annatto extract in the goat's milk candy formulation influenced the level of preference for the color attribute but did not affect on the aroma, taste, and texture attributes.

The goat's milk soft candy with the addition of 30% annatto extract as a natural colorant and antioxidant produced the best physicochemical and sensory characteristics based on index effectivity value. This soft candy innovation resulted in a water content of 7.46±0.74%, ash content of 0.57±0.07%, and antioxidant activity of 69.20±1.07%. The use of annatto extract coloring also does not affect the ash content or water content of the goat's milk soft candy produced.

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