Food and Applied Bioscience Journal, 2020, 8(3): 29−37

Development of gummy jelly mixed with *Thunbergia laurifolia* Linn. extract for reducing breath alcohol concentration

Thanapon Kitpot*, Kanokwan Promjeen and Sanipon Chanburee

Abstract

This study aimed to develop gummy jelly mixed with *Thunbergia laurifolia* Linn. extract for reducing breath alcohol content. Three levels of *Thunbergia laurifolia* Linn. extract gummy jelly; 5, 10 and 15% (w/w) were developed. The optimum formula of gummy jelly from consumer test consisted of sugar 30%, glucose syrup 28%, gelatin 8%, citric acid 2% and *Thunbergia laurifolia* Linn. extract 10%. The texture properties of the gummy jelly were as follow: hardness 702.17 ± 49.70 g, cohesiveness 0.95 ± 0.02, springiness 0.93 ± 0.02, gumminess 644.17 ± 47.09 and chewiness 603.33 ± 43.84 g. Color values (L*, a* and b*) of gummy jelly were 34.70 ± 1.31, 1.63 ± 0.28 and 5.85 ± 0.41, respectively. Water activity (a_w) of the final product was 0.77 ± 0.01. The microbial properties were compatible with the Thai jelly standard. From the preliminary *in vitro* study of the effect of gummy jelly on the reduction of alcohol content measured by hydrometer, it was found that gummy jelly mixed with *Thunbergia laurifolia* Linn. could reduce alcohol content in the breath. Preliminary efficacy test was conducted in 15 volunteers, with an average age of 22.4 ± 0.9 years. It was found that eating 5 pieces (5.0 ± 0.5 g per one piece) of gummy jelly could reduce the amount of alcohol in the breath from 0.164 ± 0.002% to 0.000 ± 0.001% by using a breath alcohol tester (reported in term of %BAC, blood alcohol content). This research demonstrated the potential of gummy jelly mixed with *Thunbergia laurifolia* Linn. extract that could help to reduce breath alcohol concentration which just lower the risk of accident rates after drinking alcoholic beverages.

Keywords: *Thunbergia laurifolia* Linn. extract, gummy jelly, alcohol, breath alcohol concentration, breath alcohol reduction

Agro−Industrial Product Development Division, Faculty of Food and Agriculture Technology, Pibulsongkram Rajabhat University, Phitsanulok, 65000, Thailand

**Corresponding author. E−mail: home393@hotmail.com*

Received: 26 February 2020, Accepted: 23 July 2020

Food and Applied Bioscience Journal, 2020, 8(3): 29−37

1. Introduction

Currently, alcohol consumption causes injuries and deaths from motor vehicles. From the statistics of road traffic accidents during 2006−2013, the numbers of injuries and deaths from drinking alcohol and driving is increasing every year in every province, especially during important festivals in Thailand (National Statistical Office, 2016). In this regard, the relevant government agencies have established a law to limit the blood alcohol content of motor vehicle drivers not more than 50 milligrams percent (not more than 0.05 %BAC, blood alcohol content). Anyone who is detected that blood alcohol content exceeds the amount prescribed by law would consider being drunk and has legal penalties. This protocol is set for health and safety purposes of motor vehicles as well as to reduce road accidents for motorists and pedestrians. In addition to exercising to reduce alcohol, there are some studies that reduce the amount of alcohol in the body by using traditional Thai herbs. From the study of effects of *Thunbergia laurifolia* Linn. on alcohol withdrawal syndrome and the alterations on the dopaminergic system in adult male rats, *Thunbergia laurifolia* Linn. was used in experiments on alcoholic male rats. They were fed with *Thunbergia laurifolia* Linn. extract continuously for 14 days. The result showed that the extract increased the positive effect of depression and repeated behavior changes. Alcohol deficiency, especially depression, and damaged nerve cells in the mesolimbic pathway of the brain were recurring after fed extract continuously for 14 days (Krasuaythong, 2006).

From the previous information, the researcher had the idea to develop a product that could reduce the amount of alcohol in the body by using Thai herbs (*Thunbergia laurifolia* Linn.). A soft gummy jelly was selected because it can be eaten easily and become popular among teenagers and working people, and the gummy products have more than 50% market share in the candy market of Thailand (Sudpanya *et al.,* 2018). Furthermore, gummy jelly is becoming popular in Asian and Europe countries, especially herbal jelly trend in China (Anirut, 2019; Pantawan, 2017). Therefore, the aim of this study was to develop gummy jelly herbal products from Thai herbs (*Thunbergia laurifolia* Linn.) for reducing breath alcohol concentration and adding value to Thai herbs.

Food and Applied Bioscience Journal, 2020, 8(3): 29–37

2. Materials and Methods

2.1 Preparation of gummy jelly mixed with *Thunbergia laurifolia* Linn. extract

Thunbergia laurifolia Linn. extract was obtained from Specialty Natural Product Co., Ltd., Bangkok, Thailand. The production of gummy jelly with *Thunbergia laurifolia* Linn. extract product was developed based on the gummy jelly method described by Charoen *et al.* (2015) and Saeng–on *et al.* (2015) with some modifications. The herbal extract was varied in 3 concentrations (5, 10 and 15 percent) to produce gummy jellies.

2.2 Analysis of physical, chemical and microbial properties

The color values of gummy jelly samples were measured by a chromameter (CR–210, Konica–Minolta, Konica–Minolta Inc., Japan) using L*, a*, b* values to describe the color of the samples. The water activity (a_w) of the samples were measured by water activity meter (CX3TE, AQUA Lab, Decagon Devices Inc., WA, USA). Texture properties of gummy jelly samples, texture profile analysis (TPA), hardness, cohesiveness, springiness, gumminess and chewiness, were analyzed by texture analyzer (TA.XT plus, Stable Micro Systems Ltd., Surrey, UK). Microbial analysis, total plate count (TPC) and yeast and mold, of gummy jelly samples were analyzed according to BAM (2001).

2.3 Sensory evaluation

The consumer acceptance test of developed gummy jelly samples was performed by consumers (n = 30). The three samples (5 g per one piece of sample) were coded with 3–digit random numbers and served to consumers. Overall liking, appearance, color, odor, overall taste, gumminess and hardness based on a 9–point hedonic scale (1 = dislike extremely, 5 = neither like nor dislike, and 9 = like extremely) were evaluated (Puttamee *et al.,* 2016).

2.4 The preliminary *in vitro* study on the reduction of alcohol content

The developed gummy jelly mixed with 10% of *Thunbergia laurifolia* Linn. extract was used to study the reduction of alcohol content in an alcoholic beverage. One piece of gummy jelly (5 g) was blended with 100 mL Ruang Khao White Spirit liquor (40% alcohol content, alc/voL) (Thai Beverage Plc., Bangkok, Thailand) for 2 min at 27 ± 2 degrees Celsius. The alcohol content of the final mixed solution was measured by hydrometer (Fisherbrand, Thermo Fisher Scientific Inc., MA, USA). Five pieces of gummy jelly per 100 mL White Spirit liquor (40% alc/voL) was conducted in this study with 3 replications.

2.5 The preliminary *in vivo* efficacy test on the reduction of alcohol content

The developed gummy jelly mixed with 10% of *Thunbergia laurifolia* Linn. extract was used to study a preliminary efficacy test on the reduction of alcohol content in humans. A preliminary efficacy test was conducted in 15 volunteers (average age = 22.4 ± 0.9 years old) who usually consume alcoholic beverages. Before test conducting, volunteers were asked

Food and Applied Bioscience Journal, 2020, 8(3): 29-37

to test with breath alcohol tester (ALC-1, Alco-Tec Co., Ltd., Thailand) to ensure that there was no alcohol content in the body. For the efficacy test, volunteers drank 10 mL of Ruang Khao White Spirit liquor (40% alc/voL) (Thai Beverage Plc., Bangkok, Thailand) and measured breath alcohol content (%BAC) in with breath alcohol tester after drank for 10 min. Next, volunteers were given 1 piece of gummy jelly (5 g) and measured breath alcohol content (%BAC) after ate for 10 min. The total amount of given gummy jelly was 5 pieces with the same test procedure. This test was repeatedly conducted for 3 days.

2.6 Statistical analysis

Physical and chemical properties were performed in triplicate and results were expressed as the mean ± standard deviation. The data were analyzed by an analysis of variance (ANOVA) and means were separated by Least significant difference (LSD). The results were processed by SPSS 17.0 (SPSS Inc., Chicago, IL, USA) for Windows. The significant level of ANOVA and LSD was justified at p-value lower than 0.05 ($P<0.05$).

3. Results and Discussion

3.1 Physical, chemical and microbial properties of developed gummy jellies

The different concentrations of *Thunbergia laurifolia* Linn. extract affected to the forming structure of gummy jelly. Gummy jelly with 5% and 10% extract resulted in a good shape but 15% extract could not be molded. The characteristics of gummy jelly products are shown in Fig 1 and the physical and chemical properties are shown in Table 1.

Fig 1 The gummy jelly mixed with *Thunbergia laurifolia* Linn. Extract

Food and Applied Bioscience Journal, 2020, 8(3): 29–37

Table 1 Properties of gummy jelly mixed with different *Thunbergia laurifolia* Linn. extract

Gummy jelly properties	5% extract	10% extract
L*	39.06 ± 1.10^{a}	34.70 ± 1.31^{b}
a*	1.25 ± 0.29^{b}	1.63 ± 0.28^{a}
b*	7.67 ± 0.58^{a}	5.85 ± 0.41^{b}
a_w	0.79 ± 0.03^{ns}	0.77 ± 0.01^{ns}
Hardness (g)	1588.75 ± 60.77^{a}	702.17 ± 49.70^{b}
Cohesiveness	0.98 ± 0.03^{a}	0.95 ± 0.02^{b}
Springiness	0.92 ± 0.01^{ns}	0.93 ± 0.02^{ns}
Gumminess (g)	1158.25 ± 70.79^{a}	644.17 ± 47.09^{b}
Chewiness (g)	1238.50±43.55^{a}	603.33 ± 43.84^{b}
Total plate count (CFU/g)	<25	<25
Yeast and mold (CFU/g)	<10	<10

Note: Means ± SD in the same row with different letters are significantly different (P<0.05)

The structure of gummy jelly affected by the amount of herbal extract. When adding more herbal extract, hardness, gumminess, and chewiness decreased accordingly and led to a soft gummy jelly structure. The microbial properties of gummy jelly were compatible with the Thai community product standard of soft jelly (TPC and yeast and mold were lower than 1 x 10^{4} and 100 CFU/g, respectively) (Thai Industrial Standards Institute, 2004).

3.2 Sensory evaluation of developed gummy jellies

The consumer acceptance test (n = 30) of developed gummy jelly samples was shown in Table 2.

Table 2 Sensory liking score from 9–point hedonic scaling test of gummy jelly mixed with different *Thunbergia laurifolia* Linn. extract concentration

Attributes	5% extract	10% extract
Overall liking	6.2 ± 0.8^{b}	6.9 ± 0.7^{a}
Appearance	6.1 ± 0.7^{ns}	6.4 ± 0.9^{ns}
Color	6.0 ± 0.9^{ns}	6.2 ± 0.6^{ns}
Odor	6.0 ± 0.7^{ns}	6.3 ± 0.8^{ns}
Taste	6.1 ± 0.8^{b}	6.5 ± 0.7^{a}
Gumminess	6.2 ± 0.6^{ns}	6.4 ± 0.5^{ns}
Hardness	6.4 ± 0.8^{ns}	6.6 ± 0.5^{ns}

Note: Means ± SD in the same row with different letters are significantly different (P<0.05)

Food and Applied Bioscience Journal, 2020, 8(3): 29–37

Gummy jelly with 10% *Thunbergia laurifolia* Linn. extract revealed the highest consumer satisfaction in overall liking (6.9 ± 0.7 points) and overall taste (6.5 ± 0.7 points) based on a 9–point hedonic scale. From Table 1, it could be told that a softer structure made consumers more satisfied. The optimum formula of gummy jelly consisted of sugar 30%, glucose syrup 28%, gelatin 8%, citric acid 2% and *Thunbergia laurifolia* Linn. extract 10%.

3.3 The preliminary *in vitro* study on the reduction of alcohol content

The preliminary in vitro study of gummy jelly mixed with 10% of *Thunbergia laurifolia* Linn. extract on the reduction of alcohol content results were shown in Table 3.

Table 3 The efficacy of gummy jelly mixed with *Thunbergia laurifolia* Linn. extract to reduce the alcohol content using hydrometer

Experiments	Alcohol content (% alc/vol)
Pure liquor	40.0 ± 0.0[a]
Pure liquor mixed with 1 piece of gummy jelly	20.2 ± 0.2[b]
Pure liquor mixed with 2 pieces of gummy jelly	20.1 ± 0.3[b]
Pure liquor mixed with 3 pieces of gummy jelly	15.2 ± 0.3[c]
Pure liquor mixed with 4 pieces of gummy jelly	10.3 ± 0.2[d]
Pure liquor mixed with 5 pieces of gummy jelly	0.1 ± 0.1[e]

Note: Means ± SD in the same column with different letters are significantly different ($P<0.05$)

From this result, it was found that gummy jelly mixed with *Thunbergia laurifolia* Linn. extract could reduce alcohol contents in the liquor sample solution. When adding more gummy jellies mixed herbal extract, alcohol contents decreased continuously.

The aqueous extracted from fresh leaves of *Thunbergia laurifolia Linn.* were used as antidote for insecticide, ethyl alcohol, arsenic and strychnine poisoning (Chattaviriya *et al.,* 2010). Moreover, the phenolic compounds in *Thunbergia laurifolia* Linn. extract could function as superior anti-oxidants and as well as a chelating agent (Oonsivilai *et al.,* 2008). Thus, detoxification and anti–oxidant properties of *Thunbergia laurifolia* Linn. extract showed the potential for the reduction of alcohol content.

Food and Applied Bioscience Journal, 2020, 8(3): 29–37

3.4 The preliminary in vivo efficacy test on the reduction of alcohol content

The preliminary efficacy test of gummy jelly mixed with 10% *Thunbergia laurifolia* Linn. extract on the reduction of alcohol content in volunteers was shown in Fig 2.

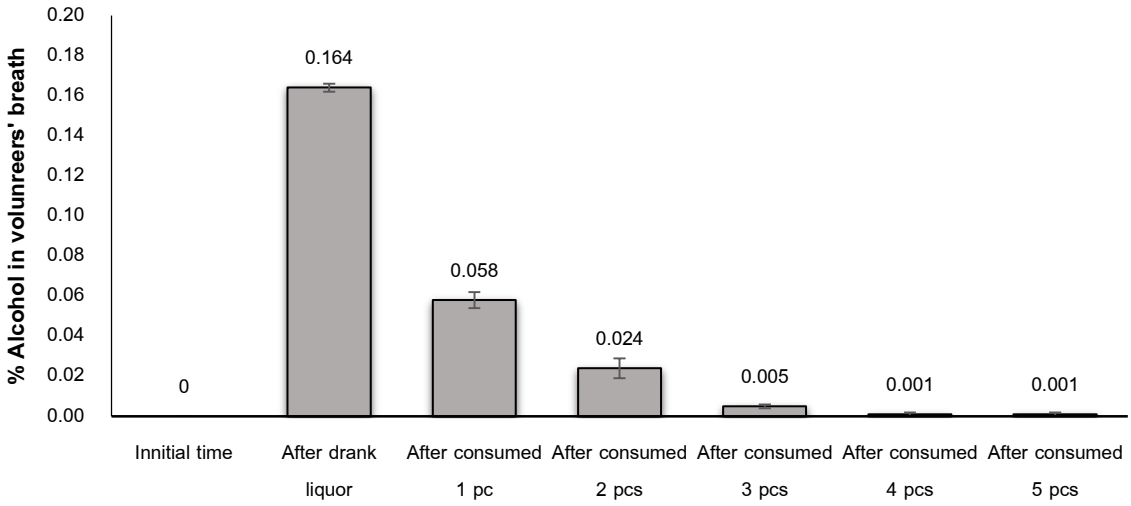

Fig 2 The efficacy test of gummy jelly containing *Thunbergia laurifolia* Linn. extract to reduce alcohol content in volunteers

When consuming more gummy jellies mixed herbal extract, breath alcohol contents decreased continuously. After eating 5 pieces of gummy jelly mixed with 10% *Thunbergia laurifolia* Linn. extract, the amount of alcohol in volunteer's breath reduced from 0.1465 ± 0.002% to 0.000 ± 0.001 % by using a breath alcohol tester (reported in term of %BAC).

Previous studies have been found that *Thunbergia laurifolia* Linn. extract possessed valuable pharmacological effects in the prevention of the after-effects related to ingesting excessive amounts of alcohol. This compound decreased blood alcohol concentration and had effective to increase metabolic activities of alcohol dehydrogenase (ADH), aldehyde dehydrogenase (ALDH) and a pharmaceutically acceptable carrier in the body (Pramyothin *et al.,* 2005; Lu *et al.,* 2009). Thus, these results demonstrated the potential of gummy jelly mixed with *Thunbergia laurifolia* Linn. extract that could help to reduce breath alcohol concentration in participated volunteers.

Food and Applied Bioscience Journal, 2020, 8(3): 29−37

4. Conclusion

From the development of gummy jelly for reducing breath alcohol content. Gummy jelly mixed with 10% (w/w) *Thunbergia laurifolia* Linn. extract was selected due to the most consumer overall liking score (6.9 ± 0.7 points). The optimum formula consisted of sugar 30%, glucose syrup 28%, gelatin 8%, citric acid 2% and *Thunbergia laurifolia* Linn. extract 10%. Water activity (a_w) of the final product was 0.77 ± 0.01. The microbial properties of the products were not over the amount of the Thai community product standard of soft jelly. From the preliminary efficacy test, eating 5 pieces of gummy jelly could reduce the amount of alcohol in the breath from 0.1465 ± 0.002% to 0.000 ± 0.001% by using a breath alcohol tester (reported in term of %BAC). This research demonstrates the potential of gummy jelly mixed with *Thunbergia laurifolia* Linn. extract that could help to reduce breath alcohol concentration which results in the reduction of accident rates after drinking alcoholic beverages.

Acknowledgements

This work was funded by Pibulsongkram Rajabhat University and Doctor Sup Herbal Company Limited, Phu Piang District, Nan Province, Thailand. Moreover, the author would like to thank Faculty of Food and Agricultural Technology, Pibulsongkram Rajabhat University for the laboratory services and scientific equipment.

References

Anirut, J. 2019. Look! 6 trends in jelly products in China that SMEs shouldn't miss. URL: https://www.smartsme.co.th/content/220075 (Retrieved on 31 October 2019).

BAM. 2001. Bacteriological Analytical Manual Online. Food and Drug Administration, Silver Spring, MD.

Charoen, R., Savedboworn, W., Phuditcharnchnakun, S. and Khuntaweetap, T. 2015. Development of antioxidant gummy jelly candy supplemented with *Psidium guajava* leaf extract. International Journal of Applied Science and Technology. 8(2): 145-151.

Chattaviriya, P., Morkmek, N., Lertprasertsuke, N. and Ruangyuttikarn, W. 2010. Drinking *Thunbergia laurifolia* Lindl. leaf extract helps prevent renal toxicity induced by cadmium in rats. Thai Journal of Toxicology. 25(2): 124-132.

Krasuaythong, N. 2006. Effects of *Thunbergia laurifolia* Linn. on alcohol withdrawal syndrome and the alterations on the dopaminergic system in adult male rats. Master of Science Thesis in Medical Physiology, Graduate School, Khon Kaen University.

Lu, L., Liu, Y., Zhu, W., Shi, J., Liu, Y., Ling, W. and Kosten, T.R. 2009. Traditional medicine in the treatment of drug addiction. The American Journal of Drug and Alcohol Abuse. 35(1): 1-11.

National Statistical Office. 2016. Statistics of road traffic accident cases classified by personal causes, environmental causes and driving equipment causes in Northern region during 2006-2015. URL: http://service.nso.go.th/nso/web/statseries/statseries21.html. (Retrieved on 1 October 2019).

Oonsivilai, R., Ferruzzi, M.G. and Ningsanond, S. 2008. Antioxidant activity and cytotoxicity of Rang Chuet (*Thunbergia laurifolia* Lindl.) extracts. Asian Journal of Food and Agro−Industry. 1(02): 116-128.

Pantawan. 2017. Schoolgirl found an opportunity to run a dessert business, transforming Thai fruit into jelly, for penetrating Asian−European markets. URL: https://www.sentangsedtee.com/ career−channel/article_59728 (Retrieved on 31 October 2019).

Pramyothin, P., Chirdchupunsare, H., Rungsipipat, A. and Chaichantipyuth, C. 2005. Hepatoprotective activity of *Thunbergia laurifolia* Linn. extract in rats treated with ethanol: In vitro and in vivo studies. Journal of Ethnopharmacology. 102(3): 408-411.

Puttamee, K., Swasdikarn, J. and Jitpattanakul, S. 2016. Effect of karanda fruit (*Carissa carandas* Linn.) and water ratio on physical, chemical properties and sensory quality of Karanda gummy jelly product. Rajabhat Rambhai Barni Research Journal. 10(3): 114-118.

Saeng-on, S., Daodee, S. and Sakloetsakun, D. 2015. Development of gummy jelly from Makmao (*Antidesma velutinosum* Blume) crude extract. Isan Journal of Pharmaceutical Sciences. 11(Supplement): 261-266.

Sudpanya, N., Asawaruangpipop, P. and Suwunnamek, O. 2018. Buying behaviors of gummy jelly in Bangkok. Journal of Administration and Management. 8(1): 101-114.

Thai Industrial Standards Institute (TISI). 2004. Thai community product standard of soft jelly. TCPS Number 519/2547.