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The Effect of Curcuma Extract Emulsion as an Amara on Ghrelin Hormone Profiles and Increased Feed Consumption in Male Rats

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ABSTRACT

Background : Curcuma (Curcuma xanthorrhiza Roxb.) contains curcuminoids and essential oils that aid bile and pancreatic function, thereby improving food absorption in the intestines and increasing appetite. However, the underlying biological mechanisms of the hormones that regulate hunger and satiety have not been extensively reported. This study aims to analyze the appetite-suppressing mechanism of curcuma rhizome extract emulsion by observing changes in ghrelin hormone levels in male Wistar rats. **Methods :** This study was an experimental study using a post-test only control group design. The test animals were divided into four groups: negative control (distilled water), and three treatment groups that received curcuma extract emulsion at different concentrations (10%, 20%, and 30%). The treatment was administered orally for 21 days. The parameters obtained included ghrelin levels in serum, which were analyzed using the ELISA method, while additional parameters included daily feed intake and weight change. The data obtained were analyzed using normality and homogeneity tests, followed by one-way ANOVA and post-hoc tests. **Results:** This study shows that administration of curcuma extract emulsion can enhance the effects of amara, as seen from increased feed intake and body weight, and by increased ghrelin levels when compared to the control. **Conclusions:** This study concluded that curcuma functions as an appetite stimulant through hormonal pathways, which has the potential to be developed as a phytopharmaceutical candidate to increase appetite through a mechanism-based approach.

Keyword: Amara; Curcuma; Ghrelin; Hunger; ELISA.

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INTRODUCTION:

Severe and prolonged eating difficulties or loss of appetite will have a negative impact on a person's health. Loss of appetite is a public health problem that has a significant impact on nutritional status and quality of life, especially in individuals at risk of malnutrition or metabolic disorders such as children. This impact will affect their growth and development and daily activities. This decrease in appetite can be caused by various factors, one of which is the condition of the hunger-stimulating hormones in the body (Kumar, 2023).

Hormones such as ghrelin and leptin play an important role as physiological regulators in maintaining energy balance and appetite.

Ghrelin is known as an orexigenic hormone that stimulates hunger, while leptin is known as an anorexigenic hormone that signals satiety to the appetite control center located in the hypothalamus. An imbalance between these two hormones has been linked to eating disorders and unhealthy weight (Kharbanda et al., 2022).

Traditional spices such as curcuma (*Curcuma xanthorrhiza* Roxb.) have long been used in traditional medicine to improve the digestive system and increase the appetite of Indonesians. curcuma contains bioactive compounds such as curcuminoids and essential oils that have carminative and cholagogue effects, which can accelerate gastric emptying and increase digestive activity, thereby potentially increasing food intake. A number of studies have also shown that Curcuma sp. can affect energy metabolism-regulating hormones and adipokines in animal and human models, although the focus on the direct relationship between curcuma, ghrelin-leptin hormones, and appetite is still very limited (Pipit Miranti et al., 2025).

Several previous studies have evaluated the effects of curcuma on body weight or food intake in animal and human models, but with different designs and parameters, such as the effect of curcuma drinks on obesity diets (Nissa et al., 2025) or the application of curcuma to increase weight in toddlers (Sri Mahasari et al., 2025). However, there is still a research gap regarding the specific hormonal mechanisms that explain how curcuma modulates ghrelin in relation to changes in feed intake and appetite indicators.

Based on the above background, this study was conducted to evaluate the effect of curcuma extract emulsion on ghrelin hormone profiles and feed consumption in rats, thereby clarifying the mechanistic role of curcuma as an appetite suppressant and providing a stronger scientific basis for the development of curcuma-based phytopharmaceuticals in the context of nutritional and metabolic health.

METHODS:

Research design

This study used an experimental study with a post-test only control group design. This study aimed to evaluate the effect of curcuma extract emulsion on ghrelin-leptin hormone profiles and feed consumption in male Wistar rats.

Materials

The materials used in this study included fresh curcuma rhizomes, distilled water, Tween 80, Na-CMC, standard mouse feed, curvit syrup, ELISA kit, standard buffer, wash buffer, ELISA substrate solution, ELISA stop solution, 0.9% NaCl, and 70% ethanol.

Equipment

The equipment used in this study included an analytical balance, blender, water bath, Buchner funnel, rotary evaporator, homogenizer, magnetic stirrer, oral probe, beaker, measuring cup, measuring flask, centrifuge, micropipette, and ELISA microplate reader.

Production of Curcuma Extract

Fresh curcuma rhizomes are harvested and sorted under running water. The sorted temulawak is sliced and arranged on a tray one by one. Dried in an oven at 50˚C around 36 hours until it completely dry. Ground into powder using a blender and strained through a 60-mesh strainer. Three hundred grams curcuma powder is macerated using 70% ethanol for 72 hours and filtered using Buchner funnel. The filtrate obtained then evaporated using a rotary evaporator to obtain a thick extract.

Production of Curcuma Emulsion

The thick extract is formulated into an emulsion with the addition of Tween 80 and Na-CMC as stabilizing agents using magnetic stirrer until homogen. Three emulsion concentrations are made, namely 10%, 20%, and 30% (w/v).

Ingredients	Fungsi	FI (10%)	FII (20%)	FIII (30%)

Ingredients	Fungsi	FI (10%)	FII (20%)	FIII (30%)
Curcuma extract	Active compound	10 g	20 g	30 g
Tween 80	Emulsifier	2 ml	3 ml	4 ml
Na-CMC	Stabilizer	0,5 g	0,75 g	1 g
Aquadest	Solvent	ad 100 ml	ad 100 ml	ad 100 ml

Test Animals

A total of 24 healthy male Wistar rats, aged 8–10 weeks with a body weight of 150–200 grams, were obtained from an accredited animal testing facility. The animals were acclimatized for 7 days in controlled environmental conditions (temperature 22–25°C, 12-hour light/dark cycle) with ad libitum access to food and water. The mice were randomly divided into five groups (n = 6 per group), namely:

a. Negative control (distilled water)
b. 10% curcuma emulsion administer 500 mg/kgBB (100 mg/200 g)
c. 20% curcuma emulsion administer 1000 mg/kgBB
d. 30% curcuma emulsion administer 1500 mg/kgBB

Treatment Procedure

The emulsion was administered orally using a feeding tube once a day for 21 days. The dosage was adjusted according to the body weight of the rats (1 mL/200 g BW). During treatment, daily feed consumption was recorded by measuring the difference between the feed given and the feed remaining, and body weight was measured periodically using an analytical scale.

Hormone Analysis

On day 22, the rats were fasted for 8-10 hours and then anesthetized. Blood samples were taken via cardiac puncture and placed in tubes without anticoagulants, then centrifuged at 3000 rpm for 15 minutes to obtain serum.

Ghrelin hormone levels were measured using the Enzyme-Linked Immunosorbent Assay (ELISA) method. Absorbance was read using a microplate reader at a wavelength of 450 nm, and hormone concentrations were calculated based on a standard curve.

Data Analysis

Data are presented as mean ± standard deviation (SD). Statistical analysis was performed using One Way ANOVA followed by Tukey's post hoc test to determine differences between groups. A p-value < 0.05 was considered statistically significant.

Research Ethics

This study was approved by the Animal Research Ethics Committee and conducted in accordance with laboratory animal welfare guidelines.

RESULTS:

General Characteristics of Test Animals

During the 21-day treatment period, all rats were healthy and showed no signs of toxicity or significant behavioral changes. There were no deaths among the test animals during the study.

Daily Feed Consumption of Mice

Administration of curcuma rhizome extract emulsion for 21 days showed an increase in feed consumption in the treatment group compared to the negative control. The increase in feed consumption was seen in line with the increase in curcuma emulsion concentration, with the highest consumption in the 30% concentration group.

Table 1. Average Daily Feed Consumption of Male Mice

Group	Feed Consumption (g/day) ± SD
Negative control	18,4 ± 1,2
10% curcuma	20,7 ± 1,5
20% curcuma	22,9 ± 1,7
30% curcuma	24,3 ± 1,4

The results of the one-way ANOVA test showed significant differences between groups

($p < 0.05$). The 20% and 30% curcuma groups were significantly different from the negative control.

Body Weight Changes

Body weight measurements were taken at the beginning and end of the treatment. All treatment groups showed a higher increase in body weight compared to the negative control. All treatment groups experienced an increase in body weight after administration of the curcuma emulsion. The greatest increase in body weight was found in the 30% curcuma concentration group, approaching the effect produced by the positive control.

Table 2. Average Weight Gain in Mice After 21 Days

Group	Initial Weight (g)	Final Weight (g)	Average
Negative control	171,2 ± 6,5	182,4 ± 7,1	11,2 ± 2,3
10% curcuma	170,8 ± 5,9	186,9 ± 6,8	16,1 ± 2,7
20% curcuma	172,1 ± 6,2	191,7 ± 7,4	19,6 ± 3,1
30% curcuma	171,5 ± 6,7	195,8 ± 6,9	24,3 ± 2,8

Post-hoc analysis showed that the 30% curcuma group was not significantly different from the positive control ($p > 0.05$).

Ghrelin Hormone Levels

Serum ghrelin level testing using the ELISA method showed a significant increase in the treatment group compared to the negative control, especially at a concentration of 30%.

Table 3. Serum Ghrelin Levels in Mice

Group	Feed Consumption (g/day) ± SD
Negative control	95,3 ± 6,4
10% curcuma	118,7 ± 8,2
20% curcuma	137,9 ± 9,5
30% curcuma	152,4 ± 7,8

Oral administration of curcuma rhizome extract emulsion has been shown to increase appetite in male rats, as evidenced by increased feed consumption and body weight. This effect increases with higher emulsion concentrations, with a 30% concentration providing the most optimal effect. These results support the role of curcuma as an appetite stimulant that works on a dose-response basis.

One-Way ANOVA analysis showed $p = 0.000$ that the 30% curcuma group was significantly different from the positive control ($p < 0.05$)

Hormonally, increased appetite is associated with elevated levels of ghrelin, an orexigenic hormone that plays a role in stimulating the hunger center in the hypothalamus. The curcuminoid and essential oil content in curcuma can increase ghrelin secretion through stimulation of the digestive system and acceleration of gastric emptying. This is consistent with the increase in feed consumption observed during treatment. The increase in ghrelin indicates that curcuma extract emulsion works through ghrelin hormonal regulation, not just mechanical effects on the digestive tract.

The group of mice using curcuma extract at a concentration of 30% showed effectiveness equivalent to the positive control, indicating the potential of curcuma as a mechanism-based phytopharmaceutical candidate for increasing appetite. These findings reinforce the development of curcuma in emulsion preparations as a safer, natural-based alternative appetite stimulant.

Anova

Waktu Kematian

	Sum of Squares	*df*	*Mean Squares*	F	*Sig.*
Between Groups	*124.450*	*3*	*18.240*	*18.240*	*.000*
Between Groups	*352.120*	*3*	*24.115*	*24.115*	*.000*
Between Groups	*1145.620*	*3*	*32.450*	*32.450*	*.000*

DISCUSSION:

This study shows that oral administration of curcuma (*Curcuma xanthorrhiza* Roxb.) extract emulsion for 21 days can increase feed intake and body weight in male Wistar rats in a dose-response manner. The most optimal effect was found at a concentration of 30%, which showed a significant increase compared to the negative control and was comparable to the positive control. These findings support the use of curcuma as an amara that works to increase appetite.

The increase in feed consumption observed in this study is related to the curcuminoid and essential oil content in curcuma. Physiologically, bitter compounds (amara) can stimulate bitter taste receptors in the gastrointestinal tract, which in turn increases the secretion of saliva, stomach acid, and digestive enzymes. This stimulation can accelerate gastric emptying and increase appetite. This peripheral mechanism contributes to increased food intake, which ultimately leads to weight gain. In addition to peripheral effects, this study also showed significant changes in hormonal profiles, namely an increase in ghrelin levels in the treatment group. Ghrelin is an orexigenic hormone produced mainly in the stomach and plays a role in stimulating the hunger center in the hypothalamus through the activation of neuropeptide Y (NPY) and agouti-related peptide (AgRP) neurons. The increase in ghrelin levels in the curcuma group, particularly at a concentration of 30%, indicates that the effect of increased appetite is not only local to the digestive system but also involves neuroendocrine regulation.

The antagonistic relationship between ghrelin and leptin is an important physiological mechanism in regulating energy homeostasis. Under normal conditions, these two hormones work in opposition to maintain a balance between energy intake and expenditure. The results of this study show that curcuma extract emulsion is able to shift this balance towards an orexigenic state, thereby supporting increased feed consumption and weight gain.

Compared to previous studies, most research on curcuma has only assessed its effects on body weight or digestive function without simultaneously evaluating hormonal parameters. This study provides a new contribution by linking the effects of curcuma amara with changes in ghrelin profiles, thereby strengthening our understanding of the molecular mechanisms underlying the effects of increased appetite.

The effectiveness of the 30% concentration, which is comparable to the positive control, demonstrates the potential of curcuma as a candidate for a phytopharmaceutical based on hormonal mechanisms. The formulation in the form of an emulsion also provides pharmaceutical advantages, such as increased solubility of the active compound and the possibility of increased bioavailability compared to traditional crude drug forms. However, this study has several limitations. The evaluation was conducted over a relatively short period and only used male animal models, so generalizations to other populations are still limited. In addition, this study has not evaluated gene expression or specific molecular pathways at the hypothalamic level involved in appetite regulation.

CONCLUSIONS:

Emulsion of curcuma rhizome extract (Curcuma xanthorrhiza Roxb.) has been proven to increase appetite in male Wistar rats, as indicated by a significant increase in feed consumption and body weight. This effect is dose-dependent, with a concentration of 30% providing the most optimal results and comparable to the positive control. This increase in appetite is associated with changes in the hormonal profile, specifically an increase in ghrelin levels, indicating that the mechanism of action of curcuma is not only through stimulation of the digestive system but also through ghrelin neuroendocrine regulation. Thus, curcuma can function as an appetite stimulant through hormonal pathways, which has the potential to be developed as a phytopharmaceutical candidate for increasing appetite through a

mechanism-based approach. The limitations of this study is relatively short duration of 21 days and the use of only male animal models.

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