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Effects of The Use of Dried Purslane (*Portulaca oleracea L.*) in Japanese Quail Rations on Growth Performance and Some Carcass Parameters

Japon Bıldırcın Rasyonlarında Kurutulmuş Semizotu (*Portulaca oleracea L.*) Kullanımının Büyüme Performansı ve Bazı Karkas Parametreleri Üzerine Etkisi *

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Abstract: This study was carried out to determine the effects of dried purslane (*Portulaca oleracea* L.) added to quail rations in different proportions on growth performance, some blood and carcass parameters and some meat quality characteristics. In the study, a total of 256 one-day-old quails were used, distributed to four treatment groups in four replications. The treatment groups consisted of: (1) Control (C, no purslane), (2) 2% dried purslane added to control feed, (3) 4% dried purslane added to control feed, and (4) 6% dried purslane added to control feed. It was determined that none of the concentrations of purslane used in the study had a significant effect on growth performance, meat quality parameters or slaughter parameters except for small intestine weight and warm carcass yield. The addition of 4 and 6% dried purslane to the ration significantly improved the warm carcass yield compared to the control group. However, it was observed that the addition of dried purslane caused lower proportional small intestine weight compared to the control. In conclusion, it was seen that up to 6% dried purslane can be used as an alternative feed ingredient in quail rations

.**Keywords:** Quail nutrition, meat quality, growth performance, purslane.

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Öz: Bu çalışma, bıldırcın rasyonlarına farklı oranlarda katılmış kurutulmuş semizotu (*Portulaca oleracea L.*) ilavesinin büyüme performansı, bazı kan ve karkas parametreleri ve bazı et kalite özellikleri üzerine etkilerinin belirlenmesi amacıyla yapılmıştır. Çalışmada, bir günlük yaşta toplam 256 adet bıldırcın kullanılmış ve bıldırcınlar 4 muamele grubuna 4 tekerrürlü olarak dağıtılmışlardır. Muamele grupları: (1) Kontrol (K, semizotu yok), (2) kontrol yemine % 2 kurutulmuş semizotu ilavesi, (3) kontrol yemine % 4 kurutulmuş semizotu ilavesi ve (4) kontrol yemine % 6 kurutulmuş semizotu ilave edilen gruplardan oluşturulmuştur. Muameleler grupların büyüme performansı, bazı et kalite parametreleri ve sıcak karkas randımanı ve ince bağırsak oransal ağırlığı haricinde bazı kesim parametreleri üzerine önemli bir etkisi gözlenmemiştir. Rasyona %4 ve 6 oranlarında kurutulmuş semizotu ilavesi kontrol grubuna göre sıcak karkas randımanını önemli derecede iyileştirmiştir. Ancak ince bağırsak oransal ağırlığı bakımından kurutulmuş semizotu ilavesinin kontrole göre daha düşük ince bağırsak oransal ağırlığına neden olduğu gözlenmiştir. Sonuç olarak, bıldırcın rasyonlarına %6'ya kadar kurutulmuş semizotunun alternatif bir yem maddesi olarak kullanılabileceği görülmüştür.

Anahtar Kelimeler: Bıldırcın besleme, et kalitesi, büyüme performansı, semizotu.

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INTRODUCTION

Since antibiotic residues in foods of animal origin create resistance against various pathogenic micro-organisms, the European Union has completely banned the use of antibiotic growth stimulators in animal feed as of January 1, 2006. The prohibition of the use of antibiotics in feed rations in Türkiye is within the framework of EU harmonization laws, and so there has been a trend towards alternative natural growth factors in animal nutrition rations. For this purpose, research on probiotics, prebiotics, organic acids and enzymes, as well as some medicinal and aromatic plants and their extracts, has recently intensified. There are important components in the structure of medicinal and aromatic plants which are also considered as feed additives (Levic et al., 2008). There are studies on the addition to poultry rations of thyme, rosemary (Naderiboroojerdi et al., 2022), garlic (Sukaryana and Syahpura 2022), nettle (Abdul-Majeed et al., 2021), mint (M Aly et al., 2023), artichoke (Dhiab and Ali 2023), cress (Rashnou et al., 2023) and dill (Hamodi et al.,2021) which are thought to be effective on performance as growth factors. In these studies, positive results for performance were found. It is thought that similar results can be achieved with many biologically active compounds (α-tocopherol, ascorbic acid, glutathione (Simopoulos et al., 1992) and the purslane plant contains high levels of Omega-3 fatty acids. Doğan (2008) conducted a postgraduate study in order to determine the effect of purslane added at different rates to laying hen rations on performance, egg cholesterol and the amount of omega-3 fatty acids. They concluded that it has effects on the skin and in addition increases the amount of omega-3 fatty acids. In another study, it was observed that the eggs were enriched with omega-3 fatty acids after the use of purslane in chicken rations (Van Elswyk,1997). Konca et al., (2015), adding purslane (*Portulaca oleracea* L.) seed to quail rations, serum triglyceride, cholesterol, high-density lipoprotein (HDL) and low-density lipoprotein (LDL) concentrations were not affected by the treatments, and 10% purslane seed addition to the ration was found to produce blood malondialdehyde. It was stated that the group with 10% purslane seed increased the blood malondialdehyde (MDA) level significantly compared to the control group and the groups with 2.5% purslane seed. In addition, the addition of 10% purslane seeds to quail diets significantly increased superoxide dismutase (SOD), catalase (CAT), glutathione peroxidase (GSH-Px) and nitric oxide (NO) values compared to other groups. It was also shown that the addition of 10% purslane seed could affect serum antioxidant levels without changing carcass characteristics or the serum lipid profile. Jian et al. (2013), showed that adding 2, 20 and 40 mg mL^{-1} purslane-derived polysaccharide to the drinking water of broilers improved growth performance. Zhao et al. (2013) reported that the addition of 0.2% and 0.4% purslane extract to the diet decreased the body weight gain and feed conversion rate and positively affected the intestinal microflora. This study aimed to determine the effects of dried purslane added to quail rations at different rates on growth performance, some blood and carcass parameters and meat quality, and as a result, to bring an alternative natural growth factor to the sector.

MATERIAL AND METHOD

The research was conducted at Bolu Abant İzzet Baysal University Experimental Animals Application and Research Center with permission dated 12 December 2018 and numbered HADYEK-2018/31 of the Animal Experiments Local Ethics Committee. Before starting the research, necessary disinfection procedures were carried out to ensure hygienic conditions. The mixed feeds used in the research were prepared by providing the necessary raw materials and feed additives containing the nutrients to meet the physiological and yield share needs of the quails and containing 24% CP and 2900 kcal kg^{-1} ME from the beginning to the end of the experiment (NRC, 1994). As a result of the analysis of the feed used in the ration, the following values were determined: 8% CP and 3350 kcal kg^{-1} ME in maize, 47% CP and 2450 kcal kg^{-1} ME in soybean meal and 26% CP and 1463 kcal kg-1 ME in dried purslane. In addition, it was determined that dried purslane contained 2.42% crude fat and 11.34% crude fiber. The rations used in the experiment are given in Table 1. In the research, 256 day-old mixed-sex Japanese quail (*Coturnix japonica*) chicks obtained from a private hatchery were used as live animal material. The room for the chicks in the research unit was heated to 33°C the day before, and suitable physical conditions of heat, light, humidity and ventilation and needed feed and water were prepared. While creating the study plan, the purchased chicks were weighed one by one and homogeneity in terms of body weight was ensured. Four mixed-sex groups (one control, three experimental) were formed, with four replications in each group and 16

animals in each replication. The purslane used in the research was obtained from the market (market or vegetable market) and dried in an oven at 105°C for 48 hours and turned into powder. Then, the ground purslane plant was mixed into the rations in certain proportions. The groups in the five-week trial were formed as follows: Group 1: Control group,Group 2: group with 2% dried purslane,Group 3: group with 4% dried purslane,Group 4: group with 6% dried purslane

In preparing the experimental group mixes, these additives were mixed into the feed homogeneously by using a mixer. Feeds were prepared weekly and stored under controlled conditions. Feeds were given ad libitum. Automatic drinkers were used to ensure that there was constant water in front of the animals.

The animal experiment part of the study was continued for 35 days. Lighting was applied as 23 hours of light and one hour of darkness. At the beginning of the experiment, the chicks were weighed individually. Then, live weight, live weight gains, feed consumption, feed conversion and survival rates were determined in weekly individual measurements from the beginning of the experiment. At the end of the experiment, a total of 32 quails, two from each replication, were slaughtered and their carcass weights, carcass yields, small intestine, gizzard, heart and liver yields were determined to a precision of 0.01 g determined by weighing on a precision balance. In addition, pH values and color measurements were made in the quail thigh and breast meat separately, and the water holding capacity (WHC,%), dry matter (DM,%), ash (%) in meat was determined.

The birds' necks were cut off after they were killed and were not used for any subsequent measurements. Once the blood had stopped flowing, the hot carcass weights were calculated. Following a 15-minute duration, the weights of the giblet (heart weight, liver weight and gizzard weight) were determined using a standard (± 1 mg) scale (TEM TNT 015D, Türkiye). The yields of giblets (heart yield , liver yield, small intestine yield and gizzard yield) and hot carcass yield were computed using this data.

Analyses of dry matter (DM), ash content, pH, water-holding capacity (WHC), and color were also carried out to look at how various treatments affected the quality of the meat. The DM plates were dried at 105°C, and the tares of these plates were measured in order to get DM data. The samples weighed 5 g using a Radwag AS220R2, Poland, laboratory scale with an accuracy of ± 0.01 g. After that, the samples were put on DM plates, dried at 105°C until a stable weight was reached, and then reweighed to find the meat's water content prior to the treatment. About 1.5 g of the samples were weighed into the tared ash capsules, which were then dried at 105°C in a drying chamber. The temperature of the muffle furnace was then gradually raised to 250–400–550°C in order to ascertain the samples' total ash content. The percentage of ash content in the sample was determined by calculating the difference between the weighings of the ash capsules that had cooled in the desiccator after the burning procedure was completed and the sample had taken on a gray-white hue. The procedure was followed as described by Jensen et al. (2004) and the Association of Official Analytical Chemists (1990).

Using a glass pH probe (Mettler Toledo A 209, USA) and an automated pH meter (Mettler Toledo A 209, USA), the pH level of the thigh and breast meat was determined. The equipment was calibrated using ready-to-use pH 4 and pH 7 solutions prior to performing the readings. Separate measurements were made from the same spots on the breast and thigh four hours after slaughter, and the samples were cooled for twenty-four hours at +4°C (Eratalar et al., 2022).

The WHC values were extracted from the same sections of the thigh and breast meat as the DM samples using the filter paper press technique, as suggested by Grau et al. (1953). Samples weighing a total of 300 mg were sandwiched between filter paper and millimeter paper, numbered one at a time, and compressed for three minutes between two unique plexiglass plates. The measurements were obtained both 24 and 48 hours following the killing. After removing the samples from the press, the two pieces of paper were stapled together in the corner. A digital SLR camera (Canon T1i, Japan) with a lens of 18–55 f was mounted to a tripod that was put up inverted on the laboratory table in order to take macro pictures of the table's surface using a light box under normal illumination circumstances. The prepared samples were set up beneath the platform so that pictures could be taken. After transferring these images to the

computer, the area of meat and the area of water distribution were calculated using JI (JImage Imaging program – National Institutes of Health 2022, USA) area computation program. To get the free water space, the spread meat area was separated from the spread water area. By dividing the free water area by the total area, the WHC values were computed as a percentage based on the data.

Table 1. The Structure and Nutrient Content of the Mixed Feeds Used in the Research (%)
Çizelge 1. Araştırmada Kullanılan Karma Yemlerin Yapısı ve Besin Maddeleri İçeriği (%)

Feed Materials	Control	2% purslane	4% purslane	6% purslane
Maize	54.5	52.63	50.95	49.31
Soybean Meal	41.7	40.98	40.15	39.26
Dried purslane	0	2	4	6
Vegetable oil	0.6	1.19	1.7	2.23
Salt	0.3	0.3	0.3	0.3
Limestone	1.2	1.2	1.2	1.2
Dicalcium phosphate (DCP)	1.1	1.1	1.1	1.1
Vitmix	0.25	0.25	0.25	0.25
Minmix	0.10	0.10	0.10	0.10
DL-Methionine	0.10	0.10	0.10	0.10
L-Lysine	0.15	0.15	0.15	0.15
Calculated Compositions				
Dry Matter (%)	89	88.75	88.84	89.01
Crude Protein (%)	23.96	23.99	23.99	23.96
Metabolizable Energy (kcal kg^{-1})	2899	2898	2895	2893
Crude fat (%)	8.10	8.40	8.45	8.51
Crude fibre (%)	4.45	5.21	5.32	5.53
Calcium (%)	0.85	0.88	0.87	0.90
Available phosphorus (%)	0.30	0.33	0.32	0.34
Lysine (%)	1.22	1.27	1.29	1.25
Methione (%)	0.50	0.51	0.49	0.53
Methionine+Systine (%)	0.75	0.77	0.71	0.70

* Vitamin mineral mix: each kilogram of vitamin and mineral mix; 12 000 000 IU A, 2 640 000 IU vitamin D3, 60 g vitamin E, 40g vitamin K3, 2 g vitamin B1, 6 g vitamin B2, 40 g niacin, 12 g pantothenic acid, 3 g vitamin B6, 0, Contains 0.3 g B12 vitamin, 2 g folic acid, 0.20 g biotin, 1500 mg choline, 50 g C, 150 g Mn, 120 g Fe, 150 g Zn, 25 g Cu, 0.4 g Co, 8 g Se .

Using a portable digital colorimeter (PCE_CSM5, PCE Instruments, USA), the color measurements were obtained from the thigh meat without skin and the breast without skin. A given plate with black and white on it was used to precalibrate the colorimeter. By evaluating ten samples simultaneously, a second colorimeter (a Minolta CR-400, Osaka, Japan) verified that the colorimeter was providing accurate readings. To determine the L, a*, b*, values were taken as color parameters from the automated colorimeter. The CIELab system examined the color parameters, with a value indicating green to red (−60 to +60), a value indicating dark to bright (0–100), and a value indicating blue to yellow (−60 to +60) (Eratalar et al., 2022).

The experiment was carried out according to the randomized plots experimental plan; the data obtained at the end of the experiment were subjected to analysis of variance and the differences between the group averages were determined by the Tukey multiple comparison test. Statistical analyzes in the study were performed with the help of SPSS 20.0 statistical package program.

RESULTS AND DISCUSSION

As seen in Table 2, no statistically significant difference was found in terms of performance data (body weight, body weight gain (BWG), feed consumption (FI), feed conversion ratio (FCR) or survival rate) as a result of using 2%, 4% and 6% dried purslane in the rations of Japanese quails.

Table 2: Performance data
Çizelge 2. Performans verileri

	Dried purslane levels, %					
Performance data	**0**	**2**	**4**	**6**	**SEM[a]**	**P value[b]**
			Body weight, g			
Beginning	7.89	7.82	7.82	7.85	0.062	0.712
Week 1	17.91	18.90	18.48	18.82	0.543	0.601
Week 3	91.80	97.86	98.80	100.52	4.383	0.712
Week 5	166.60	169.58	169.69	169.64	3.888	0.930
			Body weight gain, g			
Days 0-7	10.01	11.11	10.66	11.00	0.550	0.544
Days 0-21	83.9	90.07	90.97	92.70	4.333	0.703
Days 0-35	158.71	161.80	161.86	161.82	3.868	0.924
			Feed Intake, g			
Days 0-7	21.69	21.08	20.68	20.52	0.477	0.364
Days 0-21	221.64	231.21	229.80	238.10	7.460	0.553
Days 0-35	510.75	540.80	529.10	548.10	14.365	0.386
			Feed convention ratio			
Days 0-7	2.21	1.91	1.95	1.87	0.108	0.245
Days 0-21	2.80	2.56	2.53	2.57	0.159	0.825
Days 0-35	3.22	3.35	3.27	3.39	0.073	0.445
			Survival rate, %			
Week 1	89.06	82.81	93.75	85.94	3.733	0.324
Week 3	81.25	78.13	85.42	82.81	4.138	0.689
Week 5	82.81	75.94	85.42	82.81	4.268	0.489

[a] **Standard error means**

Similar to these findings, Kartikasari et al. (2018) added purslane in five different concentrations to broiler rations and stated that it had no effect on body weight. In addition, Akbari et al. (2014) stated that the addition of purslane at 20, 40, 60 and 80 mg kg-1 levels to quail rations did not show a statistical difference in BWG, FI and FCR. However, unlike these findings, Wang et al. (2021) reported that 2 and 3% purslane supplementation to broiler rations increased growth performance and decreased feed conversion rate, and they attributed this to purslane supplementation increasing growth performance by modulating intestinal microbiota and supporting carbohydrate metabolism. Similarly, Elhussein et al. (2015) investigated the effects of adding purslane flour at rates of 2,4,6 and 8% to broiler rations. They reported that the use of 4% purslane flour in the ration adversely affected FI and BWG but not FCR, and they attributed this to the fact that excessive calcium can reduce the palatability of the ration. As a result, it has been reported that the 4% level in the rations is not appropriate. Researchers Alamoudi and Aljarari, (2020) also added purslane leaves at the levels of 5, 10, 15 and 20% to broiler rations and stated that the highest live weight value was reached with the addition of 20% purslane leaf. Unlike the findings in this study, it has been reported that the addition of purslane extracts to broiler rations improves feed consumption and body weight gain (Zhao et al., 2013; Ghorbani et al., 2014). It is stated that the addition

of purslane increases the utilization of nutrients by increasing the production of digestive enzymes (Lee et al., 2003). Ghorbani et al. (2013) determined that the addition of purslane used at 1% and 2% levels caused an increase in feed consumption and live weight gain, and they attributed this to the palatability of purslane.

Similar to the study conducted by Konca et al. (2015), it was stated that there was no change or difference between the groups. They attributed this result to the fact that quails were used as animal material in the experiment. The reason why there was no difference in this study can be attributed to the low concentration of the dried powder form of purslane used as a feed additive, as well as the use of quails as animal material in the study.The use of dried purslane in quail rations did not have any effect on gizzard, liver and heart proportional weights(gr/ body weight) and the pH value of thigh meat (Table 3). Similarly, Faryadi et al. (2020) reported that the 1.5% addition of purslane and zinc to quail rations did not affect the proportional weight of the heart and gizzard, but they stated, unlike the findings in this study, that the proportional weight of the liver was significantly affected, and this was due to the presence of lead in the ration rather than to purslane. In a study examining the effect of adding purslane at four different levels in the range of 2.5-20 mg kg^{-1} to broiler rations on various slaughter parameters, the addition of purslane at 20 mg kg^{-1} increased the proportional weight of the heart, but it did not affect the proportional weight of the liver. However, it was determined that the proportional weight of the heart decreased with the addition of 2.5 mg kg^{-1} purslane (Tabatabie and Shahbaz Boroujeni, 2015).

Table 3: Some carcass and viscera parameters
Çizelge 3. Bazı karkas ve iç organ parametreleri

	Dried purslane levels, %					
Carcass, Internal Organs	**0**	**2**	**4**	**6**	**SEM[a]**	**P value**
Hot carcass yield (%)	69.39 [b]	69.68 [b]	72.37 [ab]	73.15 [a]	0.844	0.007
Gizzard yield (%)	2.17	2.24	2.21	2.17	0.120	0.969
Liver yield (%)	2.28	2.40	2.64	2.22	0.190	0.500
Heart yield (%)	1.18	1.12	1.09	1.14	0.044	0.546
Small intestine yield (%)	5.30 [a]	4.52 [ab]	3.70 [bc]	3.08 [c]	0.234	0.001

[a] **Standard error means**

The use of purslane at the level of 6% in the diet significantly increased the warm carcass yield, while the use of purslane at the level of 2% significantly decreased the warm carcass yield compared to the control group. ($p<0.05$). In contrast, Kartikasari et al. (2018) stated that the use of purslane at levels of 1.5, 3, 4.5 and 6% in the ration did not have a significant effect on carcass yield. Likewise, Konca et al. (2015) reported that the addition of 10% purslane did not affect the carcass yield. There was a significant difference between the groups in terms of the proportional weights of the small intestine with the use of purslane at 4 and 6% in the diet, and the proportional weights of the small intestine were found to be significantly lower. ($p<0.05$). Konca et al. (2015) reported that the addition of 2.5% purslane seed to quail rations reduced intestinal weight. Sadeghi et al. (2016) reported that the addition of dried purslane to the ration at levels of 0.25, 0.50, 0.75 and 1% did not affect carcass yield or small intestine weight. In this study, it is thought that the levels used may have had an effect on the difference in carcass yield and small intestine weights.

As seen in Table 4, the use of dried purslane in the ration did not affect the L*, a* and b* values in breast and thigh meat, dry matter and ash levels and WHC in meat. However, although there was no significant effect on the pH level of thigh meat, the use of 6% dried purslane increased the pH level of breast meat significantly compared to other groups ($p<0.05$). No study was found in the reviewed literature on the meat quality parameters of purslane in quails. However, in studies comparing herbal extracts, it was

stated that the use of pennyroyal at 0.1 and 0.2% levels in Japanese quail rations did not affect breast meat color values (L*, a*, b*) or pH values (Ölmez et al., 2021).

Table 4: Some meat quality parameters

Çizelge 4. Bazı et kalite parametreleri

Parameter	Dried purslane levels, %					
	0	2	4	6	SEM[a]	P value
Breast L*	54.97	53.59	55.06	53.75	0.950	0.607
Breast a*	12.54	10.62	10.38	11.20	1.145	0.612
Breast b*	5.08	4.07	4.64	4.57	0.764	0.867
Thigh L*	52.95	53.53	51.58	50.18	0.945	0.125
Thigh a*	8.47	7.67	7.68	8.55	0.506	0.514
Thigh b*	1.39	1.53	1.27	1.75	0.386	0.855
Breast WHC (%)	61.15	58.65	65.74	50.93	2.360	0.128
Breast DM (%)	26.38	25.85	26.43	26.73	0.511	0.706
Breast ash (%)	1.27	1.23	1.20	1.45	0.120	0.622
Breast pH	5.81[b]	5.82[b]	5.81[b]	6.23[a]	0.045	0.001
Thigh pH	6.71	6.73	6.85	6.82	0.042	0.074

[a] **Standard error means**

Similarly, it has been reported that the meat color and pH of quail meat are not affected by the addition of mint at the levels of 0.1, 0.2 and 0.3% (Daş et al., 2020). On the other hand, it is reported that the addition of herbal extract significantly affects the L* value of the meat and does not affect the a* and b* values (Aydın, 2023). In a study evaluating the effect of different levels of green tea leaf powder (GTLP) on the physiological and meat quality parameters of Jumbo quails, it was stated that it had no effect on meat quality parameters, but improved overall feed intake and carcass performance (Mahlake et al. 2021). In addition, in a study conducted, as a result of evaluating the effects of sex and age of Japanese quails on performance, blood biochemical parameters, carcass characteristics and meat quality, male quails recorded the highest meat quality and composition values compared to females (Abou-Kassem et al., 2019). According to this study, it is thought that gender may also have an effect on the results obtained. In a different study evaluating the effect of red grape pomace powder on the physiological and meat quality responses of Japanese quails in 2002, it was concluded that the effect on meat quality characteristics was not statistically significant (Mnisi et al., 2021). In a different study using *Moringa oleifera* essential oil, quail meat parameters were examined and it was stated that no effect was observed in meat quality analyses compared to controls at the end of the study (Tekce et al., 2020). As a result, when the present study is compared with the studies in the literature, it can be said that there is harmony in terms of parameters such as meat quality and live weight gain.

No positive or negative effects were observed as a result of the research with the addition of dried purslane up to 6%, and studies can be conducted on the use of higher doses of dried purslane. In addition, it is recommended that the selection of male quails in future studies is important for the healthier conduct of the experiment, and this should be taken into account in the experimental plans to be established. Apart from these considerations, it is recommended that studies be carried out that include more blood parameters and more parameters evaluating meat quality (cooking loss, microbial studies, etc.) in future studies. In addition, it is expected that further studies will be supported by digestion trials

and will be carried out in studies on the fattening performance of quails by adding dried purslane to the feed in different concentrations.

In addition, purslane, which is especially important for children's brain development and is thought to contain the most omega-3 fatty acids among green leafy plants, may be used as feed raw material in the production of quail meat and eggs. However, it is thought that the omega 3 contained in purslane can provide functional contributions by passing into animal foods, and it would be beneficial to conduct more scientific studies to determine this.

CONFLICT OF INTEREST

Authors declared no conflict interest.

DECLARATION OF AUTHOR CONTRIBUTION

The authors contributed equally to the article.

DECLARATION OF ETHICS COMMITTEE

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