The effect of feeding different levels of dandelion leaf powder (Taraxacum officinale) in the diet on the productive and physiological performance of broiler chickens, strain Ross-308.

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Abstract

This study aimed to know the effect of feeding different levels of dandelion leaf powder on the productive and some physiological traits of broiler chickens, in which 180 one-day age chicks of the unsexed Ross 308 strain were used. The chicks were distributed randomly into 4 treatments that included each treatment (3 replicates at an average of 15 chicks for each replicate). The transactions were divided into The first (control) treatment was without addition, the second, third and fourth treatments included the addition of dandelion leaf powder at a concentration (1.0, 1.5, 2.0) g/ kg feed respectively. The results showed that there was a significant increase (P<0.05) for T2 and T4 birds in the mean live body weight and total weight gain, with a significant decrease (P <0.05) in the total feed consumption rate and obtaining the best feed conversion factor for T4 birds compared to the rest of the treatments. In addition, there was a significant decrease (P <0.05) in the blood glucose and triglyceride concentrations of the two treatments T2 and T4 birds, with a significant decrease (P <0.05) in the cholesterol concentration and a significant increase (P<0.05) in the Glutathione peroxidase concentration in the blood serum of T4 treatment birds compared to With the other treatments, a significant decrease (P <0.05) of Malnualdehyde concentration (MDA) was obtained for all additive treatments compared to control. We conclude from this that adding dandelion leaf powder at a concentration of (1.0, 2.0) g / kg feed to the broiler chickens diet has a positive effect on improving the productivity and some physiological traits of broiler chickens.
Introduction

The need for high levels of production and feed conversion Efficiency and maintaining optimal bird health is the basis for the modern poultry industry [18]. Which to some extent can be achieved by using specific feed additives which have a number of beneficial effects such as controlling pathogenic microorganisms and promoting the growth of beneficial microorganisms [15]. Antibiotics have been used in subtractive proportions for good health, stimulation of growth and economic weight gain [6]. Despite the contribution of these antibiotics as growth catalysts in the poultry industry, their use was accompanied by negative aspects represented in the accumulation of their residues in the tissues of poultry, which caused problems for consumers, as well as the emergence of strains of pathological bacteria that are not affected by antibiotics [4]. Consequently, poultry farmers have recently resorted to using medicinal plants and their extracts as anti-microbial and growth-promoting food additives instead of antibiotics and other industrial additives for the purpose of improving the productive performance of birds [9], and being safe and less toxic when used as food additives [10]. These feed additives have gained increasing interest, especially in poultry feeding, because they benefit fully affect the ecosystem of intestinal microbes by controlling potential pathogens and thus improving the internal environment of the digestive system and achieving microbial balance in the gut [11]. The dandelion plant (Taraxacum officinale) is one of these natural alternatives, and it is a perennial herb from the Asteraceae family (Compositae) used in many traditional and modern herbal medicinal systems, especially in Asia, Europe and North America [28]. Dandelion has been used as a traditional Chinese medicine to treat various ailments such as indigestion, diseases of the spleen, liver, gallbladder disorders, digestive disorders, and infections [29,25]. The dandelion plant contains many phytochemicals including polysaccharides, peptides, flavonoids, phenolic acids, alkaloids and terpenes [21], and it is a source of many different nutrients and biologically active substances and its roots and leaves contain vitamins (A, K, C and B Complex), minerals (calcium, magnesium, potassium, zinc and iron), micronutrients, fiber, lecithin and choline [22]. Several studies have shown that the extract of the dandelion plant contains a high percentage of inulin (Inuline) estimated at 40% and is considered a complex sugars that are used recently as a prebiotic, as these substances work to
maintain the microbial balance inside the gut as it is considered one of the best substances that encourage growth propagation of beneficial bacteria such as (Bifidobacterium and Lactobacilli), Which is of great importance for health and immunity [26]. Therefore, the present study aimed to know the effect of feeding different levels of powdered dandelion leaves on the productive traits and some physiological traits of broiler chickens.

Materials and methods

This field experiment was conducted in one of the (private) commercial fields of Babylon province / Al-Hashimiya district for the period from 1/3/2020 until 4/4/2020, During this study, the effect of adding different levels of dandelion powder to the diet was studied to know its effect on the productive traits and some blood parameters of broilers. 180 chicks of broiler chickens strain Ross-308, unsexed one day age, with an average weight of 40 g, were used. The chicks were raised in a prepared hall and divided into cages with the dimensions of each cage x 1.5 (1) m², according to the ground breeding system. The chicks were distributed randomly on 12 cages by 4 treatments. Each treatment included 3 replicates and each replicate included 15 birds. The chicks were fed on a starter diet from the age of (1-21) days and a final diet from the age of (22-35) days. Table 1 shows the composition of the starter and final diets used to feed the chicks throughout the experiment period and the calculated chemical composition. The dandelion powder was added from the first day as follows: the first treatment (T1) a basic diet without adding (control), the second treatment (T2), the third treatment (T3) and the fourth treatment (T4) a basic diet added to it with dandelion powder at a concentration of (1.0 , 1.5 and 2.0) g / kg feed respectively. Note that powdered dandelion was added starting from the age of one day. The following productive traits were estimated at age (21 and 35 days): live body weight, weight gain, feed consumption rate and feed conversion factor according to the equations reported by Al-[1] , in addition to some physiological traits at the end of the experiment at Omar (35 days) which included: Glucose, total protein, cholesterol, triglycerides, malnualdehyde (MDA) and glutathione peroxidase (GSH-Px) in serum where blood was collected from 6 birds from each treatment (2 birds per replicate) randomly. The blood was collected from the brachial vein (brachial vien) with tubes that do not contain anti-coagulation and in an oblique manner, then it was placed in a centrifuge at a speed of 3000 RPM /
minute to separate the blood plasma, then the serum was transferred to special, sealed test tubes and the packages were kept inside the freezer at -20°C until Measure the listed attributes. Completely Randomized Design was used to study the effect of different treatments on the studied traits, and the significant differences between the averages were compared using the Duncan polynomial test[5], and the ready statistical program SAS[24] was used to analyze the data.

**Table 1: shows the composition of the starter and final diet used to feed the chicks throughout the duration of the experiment**

| The final diet (35-22 days)% | Starter diet (1-21 days)% | Feed materials          |
|-----------------------------|---------------------------|-------------------------|
| 54                          | 51                        | yellow corn             |
| 11.5                        | 12.5                      | Wheat                   |
| 22                          | 24                        | Soybean meal 44% protein|
| 10                          | 10                        | Protein concentrate (1) *|
| 1.5                         | 1.5                       | Vegetable oil           |
| 0.7                         | 0.7                       | Limestone               |
| 0.3                         | 0.3                       | Salt                    |
| 100%                        | 100%                      | Total                   |
| 20                          | 21.49                     | Crude protein%          |
| 3150                        | 2990.5                    | Representative energy (kWh / kg feed) |
| 158                         | 139                       | The ratio of energy to protein |
| 1.14                        | 1.22                      | Lysine                  |
| 0.58                        | 0.62                      | Methionine + cysteine (%)|
| 1.26                        | 1.43                      | Calcium(%)              |
| 0.81                        | 0.90                      | Total phosphorous (%)    |
| 0.57                        | 0.67                      | phosphorous availability|

*BROCON-5 SPECIAL W protein concentrate: Chinese origin, each kg of it contains: 40% crude protein, 3.5% fat, 1% fiber, 6% calcium, 3% available phosphorous, 3.25% lysine, 3.90% methionine + cysteine 2.2% sodium, 2100 lakh kcal / kg representative energy, 20000 IU vitamin A, 40,000 IU vitamin D3, 500 mg vitamin E, 30 mg vitamin K3, 15 mg vitamin B1 + B2, 150 mg B3, 20 mg B6,300 B12 mg, 10 mg folic acid, 100 micrograms butene, 1 mg iron, 100 mg copper, 1.2 mg manganese, 800 mg zinc, 15 mg iodine, 2 mg selenium, 6 mg cobalt, 900 mg antioxidant (BHT). Chemist's for suspension according to NRC (1994).

**Results and discussion**
The results of the statistical analysis in Table 2 that show the effect of using dandelion leaf powder on the live body weight and weight gain of broiler chickens indicate that the second and third treatments were significantly excelled (P <0.05) compared to the first and fourth treatments at 21 days of age, while when chicks at the age of 35 On the day we find the birds of the second and fourth treatments significantly excelled (P <0.05) to the rest of the other treatments. We also notice in the same table that there are significant differences between all treatments in the aspect of weight gain at age (1-21 days), as the second and third treatments were significantly higher (P <0.05) compared to the first and fourth treatments. As for age (22-35 days), we find the significantly excelled of the fourth treatment significantly (P <0.05) on the rest of the treatments, while the total weight increase at the end of the experiment at age (1-35 days), we notice the significantly of the second and fourth treatments significantly (P <0.05) As compared to the first and third treatments. Perhaps the reason for the significantly of the second and fourth treatments in body weight and weight gain is that dandelion leaf powder contains active compounds that include flavonoids and alkaloids in addition to being a rich source of fiber, potassium, phosphorous, iron and vitamins that include vitamin A, C, thymine and riboflavin, which play an important role. In promoting growth and stimulating metabolic processes within the body [17], or to the vital role of the Prebiotic(dandelion leaf powder) in increasing the production of volatile fatty acids as well as raising the efficiency of the formation of many essential vitamins that the body needs for growth, the most important of which is vitamin B, As well as the main course in improving mineral absorption from feed materials [19]. In addition to its role in increasing the productivity of digestive enzymes, improving their activity and effectiveness, and thus improving the digestibility of food, which ultimately improves the metabolism of birds [7]. It is evident from Table 3, which shows that there are no significant differences between all treatments in the amount of feed consumed at the age of 21 and 35 days, but there was a significant decrease (P <0.05) in the rate of total feed consumption rate for the fourth treatment birds compared to the rest of the addition and control treatments. Also, there were no significant differences between all treatments in the traits of the feed conversion factor at the age of 21 days, while we note at age (22-35 days) the presence of significant differences between the treatments. Significant improvement (P <0.05) in the total duration (1-35 days) compared with other treatments. The improvement in the feed conversion
factor may be due to the improvement in the efficiency of the digestive system in the digestion of the ingested feed materials and thus the improvement of their absorption [28]. Or it may be due to the improvement of cumulative feed conversion ratio as a result of the effect of the vital precedent on growth performance, as it works to reduce the pH as a result of the increase in the formation of organic acids and then increase the activity of digestive enzymes that dissolve fats, sugars and proteins, and take advantage of the basic minerals and amino acids available in the diet. Digesting feed more efficiently [14], The significant improvement in productive performance when dandelion powder is added, which is a vital precedent to its containment of active substances that have the effect of limiting the proliferation of harmful bacteria inside the gastrointestinal tract and also have a role in all of these elements and compounds are necessary to build the living body in the early stages of life and maintenance on the general health of birds and their acquisition of immunity against many diseases and support for the digestive, physiological and metabolic processes inside the bird’s body, It also worked on creating an intestinal microbial balance in which the beneficial microorganisms prevailed, thus improving the efficiency of the bird's digestive system and its ability to digest and absorb food. Table 4 data that includes the effect of adding dandelion leaf powder on glucose, cholesterol, glycerides, and total protein showed a significant decrease (P <0.05) in the concentration of glucose and triglycerides in the blood serum of the birds of the second and fourth treatments compared with the first and third treatment, and a significant decrease (P <0.05) in Cholesterol concentration in the blood serum of the fourth treatment birds compared with other treatments, With no significant differences in the total protein trait between all treatments. Blood is an indicator of the expression of the physiological, pathological and nutritional status of the animal [27], the significant decrease (P <0.05) obtained in the glucose concentration may be due to the active components present in Dandelion, which has the ability to increase the level of insulin secretion from pancreatic beta cells and this led to a decrease in the concentration of glucose [13]. With regard to the significant decrease (P <0.05) of the concentration of cholesterol and triglycerides, as the thyroid gland is considered one of the most important glands in terms of cholesterol metabolism and in response to the effect of adding dandelion leaf powder, which acts as an appetite suppressant and in turn leads to an increase in the metabolism rate and an increase in thyroid gland activity and then leads to Reduced serum cholesterol [16] or the reason
may be due to the presence of alkaloids, glycosides, phenolic compounds and flavonoids in dandelion, which have a role in reducing cholesterol and triglycerides by increasing the excretion of bile [23]. The results in Table 4 showed that there were significant differences between all treatments in the level of Malnualdehyde (MDA) and Glutathione peroxidase (GSH-Px), as the level of MDA decreased significantly (P <0.05) in all treatments of the addition of dandelion leaf powder compared to the first treatment (control). While the level of GSH-Px was significantly increased (P <0.05) in the blood serum of the fourth treatment birds compared with the other treatments, due to the fact that the dandelion plant improves the free radical removal activity because it contains the antioxidants lutiolin and lutiolin-7-o-glycoside. It was shown that it has high antioxidant properties [12], and the comparison treatment (control) recorded the maximum value of MDA with a significant increase ((P <0.01) evident in the amount of MDA, which is a natural reflection of the breakdown of peroxides, as MDA is a byproduct of the process. The oxidation and degradation of pyroxides [3] (It is also considered the best measure or guide for measuring lipid oxidation in blood and tissues plasmas because it is more stable than hydroperoxides [20]. It is a sign of oxidative stress [8]. The lipid peroxidation process occurs when the production of free radicals exceeds the capacity of the anti-oxidative defense systems for their scavenging or elimination of their products, where the lipid peroxidation is formed in the fatty acids and after oxidation of those acids. Compounds with short chains are Malnoyaldehyde [2].

Table 2. The effect of feeding different levels of dandelion leaf powder in the diet on the mean live body weight and total weight gain of broiler chickens (mean ± standard error) at 21 and 35 days of age.

| Treatments | total weight gain(g) | body weight(g) | 35-1 day | 35-22 day | 21-1 day | 35 day | 21 day |
|------------|----------------------|----------------|----------|-----------|---------|--------|--------|
| T1         | 2058.41b ± 3.17       | 2095.23b ± 8.19 | 2095.23b ± 8.19 | 2071.35b ± 3.18 |
| T2         | 2105.52a ± 5.93       | 2145.64a ± 2.89 | 2145.64a ± 2.89 | 2095.23b ± 8.19 |
| T3         | 2077.95b ± 3.06       | 2118.95b ± 3.76 | 2118.95b ± 3.76 | 2071.35b ± 3.18 |
| T4         | 2126.08a ± 8.41       | 2165.08a ± 3.88 | 2165.08a ± 3.88 | 2105.52a ± 5.93 |
The averages that carry different letters within the same column differ significantly between them. * (P <0.05)

The treatments are T4, T3, T2, T1, adding dandelion leaf powder to the feed at level (1.0, 1.5, 2.0) g / kg feed, respectively.

Table 3. The effect of feeding different levels of dandelion powder in the diet on the feed consumption rate (g) and the feed conversion factor (g feed / g weight) for broilers chickens (mean ± standard error) at 21 and 35 days of age.

| Cumulative feed conversion factor (g feed / g weight) | Feed consumption rate (g) | Treatments |
|-----------------------------------------------------|---------------------------|------------|
|                                                     | 21 day                    | 35-1 day   | 35-22 day | 21-1 day | 35 day | 21 day |
|                                                     | 1.68a ± 0.023             | 1.81a ± 0.027 | 1.50a ± 0.087 | 3463.45a ± 35.30 | 2214.41 ± 10.17 | 1249.04 ± 28.29 | T1 |
|                                                     | 1.61ab ± 0.015            | 1.73ab ± 0.029 | 1.42a ± 0.053 | 3381.90bc ± 17.57 | 2154.88 ± 11.06 | 1220.02 ± 14.16 | T2 |
|                                                     | 1.64bc ± 0.026            | 1.78a ± 0.032 | 1.43a ± 0.075 | 3401.02b ± 21.70 | 2169.68 ± 15.95 | 1231.34 ± 15.95 | T3 |
|                                                     | 1.57b ± 0.021             | 1.66b ± 0.023 | 1.43a ± 0.053 | 3342.76c ± 35.67 | 2128.53 ± 14.50 | 1214.23 ± 23.38 | T4 |

The averages that carry different letters within the same column differ significantly between them.
-NS: not significant, * (P <0.05)
-The treatments are T4, T3, T2, T1, adding dandelion leaf powder to the feed at level (1.0, 1.5, 2.0) g / kg feed, respectively.
Table 4. Effect of feeding different levels of dandelion leaf powder in a diet on glucose, total protein, cholesterol, and blood triglycerides of broilers chickens (mean ± standard error) at 35 days of age.

| Treatment | Glucose (g/100 ml) | Total Protein (g/100 ml) | Cholesterol (g/100 ml) | Triglycerides (g/100 ml) |
|-----------|--------------------|--------------------------|------------------------|--------------------------|
| T1        | 194.03 ± 3.24      | 3.24 ± 0.06              | 194.03 ± 5.36          | 3.38 ± 162.49            |
| T2        | 173.76 ± 4.20      | 4.20 ± 0.13              | 173.76 ± 2.60          | 5.24 ± 139.30            |
| T3        | 189.23 ± 3.52      | 4.48 ± 0.29              | 189.23 ± 3.84          | 8.19 ± 153.50            |
| T4        | 166.50 ± 2.75      | NS                       | 166.50 ± 2.75          | 3.84 ± 152.03            |

The averages that carry different letters within the same column differ significantly between them.

- NS: not significant, * (P <0.05)

- The treatments are T4, T3, T2, T1, adding dandelion leaf powder to the feed at level (1.0, 1.5, 2.0) g / kg feed, respectively.

Table 5. The effect of feeding different levels of dandelion leaf powder in a diet on the MDA and GSH-Px concentration in broiler chickens blood serum (mean ± standard error) at 35 days of age.

| Treatment | MDA (µmol/mol) | GSH-Px (µmol/mol) |
|-----------|----------------|-------------------|
| T1        | 187.30 ± 6.49  | 3.47c ± 0.29      |
| T2        | 154.30 ± 5.81  | 4.58ab ± 0.31     |
| T3        | 162.70 ± 4.41  | 3.78bc ± 0.12     |
| T4        | 149.00 ± 4.14  | 5.27a ± 0.22      |

The averages bearing different letters within the same column differ significantly between them.

* (P <0.05)
-The parameters are T4, T3, T2, T1, adding dandelion leaf powder to the feed at level (1.0, 1.5, 2.0) g/kg feed respectively.

References

[1] Al-Fayadh, Hamdi Abdel-Aziz and Saad Abdel-Hussein Naji, 1989. Poultry Products Technology - First Edition. Directorate of Higher Education Press. Baghdad.

[2] Block C.; Dietrich M.; Norkus E.; Morrow J.D. and Poker L. 2002. Factors associated with oxidative stress in human populations. AM. J. Of epidemiol 156 (3) : 274 - 278.

[3] Demir S., Yilmaz M.; Akalin N. and Aslan D. 2003. Role of free radicals in peptic ulcer and gastritis. The Turkish journal of gastroenterology 14(1):39-43.

[4] Dibner, J.J. and J.D. Richards. 2005. Antibiotic growth promoters in agriculture: history and mode of action. International Journal of Poultry Science, 84:634–643

[5] Duncan, D.B. (1955). Multiple Rang and Multiple F-test. Biometrics. 11: 4-42.

[6] Economou, V. and P. Gousia. 2015. Agriculture and food animals as a source of antimicrobial-resistant bacteria. Infection and drug resistance, 8, 49-61.

[7] El-Iraqi, K.G and R.H. Fayed. 2012. Effect of yeast supplement on behavioral and productive performance of broiler chickens. Life Science Journal, 9 (4): 4026-4.

[8] Gawel, S.; M. Wardas; E. Niedworak, and P. Wardas. 2004. Malondialdehyde MDA as a lipid peroxidation marker. Wiad. Lek. 57:453–455.

[9] Grashorn, M. A. 2010. Use of Phytobiotics in broiler nutrition an alternative to in feed antibiotics. Journal of Animal and Feed Science 19: 338-347.

[10] Hashemi, S. R.; Zulkifli, I.; Hair Bejo, M. Farida, A., and Somchit, M. N. 2008. Acute toxicity study and phytochemical screening of selected herbal aqueous extract in broiler chickens. Int J pharmacol, 4(5), 352-360.
[11] Hashemi, S.R. and Davoodi, H. 2010. Phytogenics as new class of feed additive in poultry industry. *J. Anim. Vet. Adv.,* 9(17): 2295-2304.

[12] HU, C. and Kitts, D.D. 2004. Luteolin and luteolin-7-O-glucoside from dandelion flower suppress iNOS and COX-2 in RAW264.7 cells. Molecular and Cellular Biochemistry 265: 107-113.

[13] Hussain, Z., Waheed, A. and Qureshi, R.A. 2004. The effect of medicinal plants of Islamabad and Murree region of Pakistan on insulin secretion from INS-1 cells. Phytotherapy Research 18: 73-77.

[14] Kamel, E. R., and Mohamed, L. S. (2016). Effect of Dietary Supplementation of Probiotics, Prebiotics, Synbiotics, Organic Acids and Enzymes on Productive and Economic Efficiency of Broiler Chicks. Alexandria Journal for Veterinary Sciences, 50(1):26-32.

[15] Khan, S.H. and J. Iqbal. 2016. Recent advances in the role of organic acids in poultry nutrition. Journal of Applied Animal Research. 44: (1)359–369.

[16] Kuhn , E.R., L.R. Berghman; L. Moons, F. Vandecande; E. Decyper. and Darres. V.M. 1993. Hypothalamic and peripheral control of thyroid function during the life cycle of the chicken. In: Avian Endocrinology. Ed Sharp, P.J. Journal of Endocrinology, 8(12): 26-51.

[17] Mir M A, Sawhney S S and Jassal M M S. 2013. Qualitative and quantitative analysis of phytochemicals of *Taraxacum officinale*. Wudpecker Journal of Pharmacy and Pharmacology 2 (1): 1–5.

[18] Mohammed, H. A. 2018. Effect of organic acids supplemented in drinking water during pre-starter and starter feeding phase on broiler performance. Polytechnic Journal, 8(2), 60-69.

[19] Mountzouris, K.C.P; I. Tsitrsikos; A. Palamidi; M. Arvaniti; M. Schatzmayr and Fegeros, G.K. 2010. Effects of probiotic inclusion levels in broiler nutrition on growth
performance, nutrient digestability, plasma immunoglobulins and cercal microflora composition. Poultry Science, 89: 58-67.

[20] Pokorny, J.; N. Yanishlieva and M. Gordon. 2001. Antioxidants in food practical applications. Woodhead Publishing Ltd, Abington Hall, Abington Cambridge CB1 6AH, England edition:400

[21] Qian, L.; Zhou, Y.; Teng, Z., Du, C. L., and Tian, C. 2014. Preparation and antibacterial activity of oligosaccharides derived from dandelion. International journal of biological macromolecules, 64, 392-394.

[22] Qureshi, S.; Adil, S.; El-Hack, M. A.; Alagawany, M. and Farag, M. R. 2017. Beneficial uses of dandelion herb (Taraxacum officinale) in poultry nutrition. World's Poultry Science Journal, 73(3), 591-602.

[23] Qureshi, S.; Bavday, M.T., Adil, S.; Shakeel, I. and Munshi, Z.H. 2015. Effect of dandelion leaves and fenugreek seeds with or without enzyme addition on performance and blood biochemistry of broiler chicken and evaluation of their in vitro antibacterial activity. Indian Journal of Animal Sciences 85: 1248-1254.

[24] SAS. 2012. Statistical Analysis System, User's Guide. Statistical. Version 9.1th ed. SAS. Inst. Inc. Cary. N.C. USA.

[25] Schütz, K.; Carle, R., and Schieber, A. (2006). Taraxacum-a review on its phytochemical and pharmacological profile. Journal of ethnopharmacology, 107(3), 313-323.

[26] Torshizi, M ; A. Karimi ; S. Rahimi ; N. Mojgani and Esmacilkhanian, S . 2004. In vitro evaluation of probiotics of Lactic acid bacteria isolated from poultry digestive. Tract. 21th World’s Poultry conf. Istanbul. Turkey.

[27] Uchegbu, M. C.; Ogbuewu, I. P., and Ezebuire, L. E. 2017. Blood chemistry and haematology of finisher broilers fed with plantain (Musa paradisiaca L) peel in their diets. Comparative Clinical Pathology, 26(3), 605-609.
[28] Yarnell E and Abascal J D. 2009. Dandelion (Taraxacum officinale and T. mongolicum). Integrative Medicine 8 (2): 310–16.

[29] You, Y.; Yoo, S.; Yoon, H. G.; Park, J., Lee, Y. H., Kim, S. and Jun, W. 2010. In vitro and in vivo hepatoprotective effects of the aqueous extract from Taraxacum officinale (dandelion) root against alcohol-induced oxidative stress. Food and Chemical Toxicology, 48(6), 1632-1637.