Original Research Article **Biotechnology**

International Journal of Pharma and Bio Sciences

ISSN
0975-6299

COMPARATIVE STUDY ON PHYSICO-CHEMICAL OF FREEZE AND HOT-AIR DRIED GOAT LEG EXTRACT.

SRUTHI D[1], SASIKALA SHANMUGAM[1*]

Department of Food Process Engineering, SRM University, Kancheepuram, Tamil Nadu, India

ABSTRACT

Dietary habits are major factor in development of obesity and cardiovascular heart diseases. Foods from animal source have been a part of human diets for years. Goat meat also contains higher levels of iron, potassium, thiamine, and lower levels of sodium than beef. Considering its high nutritional value and its greater unsaturated to saturated fatty acid ratio, goat meat has the potential to improve health A systematic study to evaluate on how two drying methods namely hot air drying and freeze drying effects the goat leg meat water extract while conversion of the extract to powder form. Comparative studies were done on physicochemical and functional properties of the hot air and frieze dried powder which is critical for the utilization of the powder as an ingredient in food products. The water absorption capacity of the freeze-dried powder was higher than that of hot air dried. Similarly, solubility and rehydration ratio was comparatively higher for freeze dried powder. Results suggested that the freeze-dried powder could be a better for incorporating as food ingredient than the hot- air dried powder. Drying effects on its Total Phenolic Content [TPC] and Scavenging Activity [SA] was assayed which revealed that the freeze-dried sample showed a higher TPC than tray dried sample. Similarly freeze dried sample possessed better antioxidant activity than tray dried sample. On comparison with fresh sample small amount of changes were observed on both phenolic content and scavenging activity.

KEYWORDS: ***Freeze dried; Hot air dried; Physico chemical; antioxidant;***

SASIKALA SHANMUGAM*

Department of Food Process Engineering, SRM University, Kancheepuram, Tamil Nadu, India

Received on: 10-05-2017
Revised and Accepted on: 18-09-2017
DOI: http://dx.doi.org/10.22376/ijpbs.2017.8.4.b280-285

INTRODUCTION

Goats are now widely distributed around the world, totaling more than 850 million and representing about 1,156 different breeds [1]. On a global scale, goat meat consumption is less than beef [2], but goats undoubtedly serve as a staple source of red meat to humans [3], especially in developing countries. In somehow, pretty much every culture all through history has utilized a type of bone soup to enhance wellbeing and bolster a solid invulnerable framework. In old China, for instance, gelatin was prized as a characteristic approach to keep up muscle quality, bone thickness and simplicity of development into more established age, since it secures joints, bones and muscle tissue from harm. [4].Our progenitors esteemed bone juices as a "nose-to-tail" way to deal with utilizing all parts of a creature, including the bone marrow and skin that are regularly disposed of today. Utilizing these parts was a modest, helpful approach to acquire a wealth of minerals, proteins and different supplements while additionally seasoning formulas and maintaining a strategic distance from waste. Powder is the most well-known type of nourishment added substances, as it is the most stable type of characteristic items that is anything but difficult to utilize and easy to pack, circulate, and handle[5]. Dried powdered items can be effortlessly connected in various foodstuffs, and even pharmaceutical items, to enhance their shading and flavor[6] and, in the meantime, to give the human body extra wellbeing related constituents. Among the drying systems presently used to get powders from fluid stop drying is thought to be the best strategy on the grounds that the low-temperatures connected in this procedure permit the most elevated maintenance of healthful mixes [7].Hot air-drying is all the more normally utilized as a part of nourishment industry as it is moderately less expensive however the delayed drying time more often than not brings about sub-par item quality[8]. Solidify drying, otherwise called lyophilisation or cryo-drying up is a procedure of evacuation of water and is utilized to protect a material or make the material more helpful for transport. The key of stop drying includes solidifying the material and afterward lessening the encompassing weight in order to permit the solidified water to sublimate specifically from the strong stage to the vaporous stage. Among the different drying forms, solidify drying gives most elevated item quality yet the moderately high creation cost is a noteworthy downside of the procedure. This study deals up with the extraction of goat leg using water and drying of the liquid and thus the dried powder can be further used in functional foods. In this a comparison regarding the effect of drying of goat leg extract by freeze and hot–air drying on its physicochemical and functional properties were studied.

MATERIALS AND METHODS

Collection of Raw Materials and Preparation

Fresh goat leg were procured from Urappakam ,Chennai of breed *Osmanabadi* and were burned for 10 mins and cleaned thoroughly.For extraction of the bone constituents hot water extraction was done in normal pressure at 95 to 105°C for 1 to 2 hours after mixing the goat leg and purified water in a weight ratio of 1:1.5 to 1:7.The bones were then removed and the extract was subjected for drying.

Hot Air Drying of the Goat Leg Extract

The extract of goat leg was poured over plates and subjected for hot-air drying in tray drier (Inlab HE 12 TD) at 50°C. Drying was carried out until the samples reached constant weight. After drying the samples were scratched from the plates and stored in aluminum packages at 4ºC.The yield was then calculated with the amount of sample obtained by subjecting 50ml of extract.

Freeze Drying of Goat leg Extract

The goat leg extract was pre freezed at -5°C for 2 days and subjected for freeze drying in a freeze drier (Lyodel EOPRY1-11) at -40°C at a pressure of -3mbar for 3 days to obtain freeze dried goat leg extract powder which was then scratched out from the plates and stored in aluminum packages at 4ºC. The yield was then calculated with the amount of sample obtained by subjecting 50ml of extract.

Determination of Physicochemical properties

Density Analysis

The Density analysis such as bulk density, tapped density, Hausner ratio and Carr's index were determined according to Lee et al [9] based on Eq 1-4.

$$\text{Bulk Density} = \frac{\text{Weight (g)}}{\text{Volume (ml)}} \quad \text{....(1)}$$

$$\text{Tapped Density} = \frac{\text{Weight (g)}}{\text{Volume (ml)}} \quad \text{....(2)}$$

$$\text{Hausner Ratio (HR)} = \frac{\text{Tapped Density}}{\text{Bulk Density}} \quad \text{....(3)}$$

$$\text{Carr's Index (CI)} = \frac{\text{Tapped Density} - \text{Bulk Density}}{\text{Tapped Density}} * 100 \quad \text{....(4)}$$

Rehydration Ratio

Rehydration ratio (RR) was resolved by the strategy depicted by Pervin et al [10]. Rehydration proportion is the one of vital consider the dried out products.0.5g of goat leg extract powder was added to 50ml of water and boiled for 10 minutes. The sample was put on Whatmann no.4 channel paper to drain off the overabundance water. The residue was then weighed and the rehydration ratio was calculated according to the Eq 5.

$$\text{Rehydration Ratio}(\%) = \frac{\text{Weight of Rehydrated sample}(g)}{\text{Weight of Dehydrated sample}(g)} * 100 \quad \ldots(5)$$

Determination of Water absorption capacity (WAC)

The WAC of the samples was determined using the method described by Elaveniya et al [5] .0.5g of sample was weighed into a tube and vortexed with 20ml of distilled water. The tubes were then heated on a water bath at 60°C for 30minutes and then were cooled to room temperature and centrifuged at 2200 rpm for 15min.The pellet is weighed and water absorption capacity of the sample is measured using the formula

$$WAC = \frac{weight\ of\ pellet - weight\ of\ sample}{weight\ of\ sample} \quad \ldots..(6)$$

Solubility

Solubility of the samples were analysed according to Elaveniya et al [5]. 5g of sample was weighed into a centrifuge tube and mixed with 25ml of distilled water and heated in a water bath at 60°C for 30minutes.The tubes were cooled to room temperature and centrifuged at 2200 rpm for 15min.The supernatant is transferred to a beaker and the solvent was evaporated. The weight of the precipitate in the beaker is noted and solubility was calculated as:

$$\text{Solubility}(\%) = \frac{\text{Weight of Dry sample in Supernatant}\ (g)}{\text{Weight of Original sample}(g)} * 100 \quad \ldots..(7)$$

Water Activity

Water activity aw demonstrates how firmly water is bound in an item. It is an immediate estimation of the free, unbound or "dynamic" water that is accessible to take an interest in the synthetic responses that impact numerous item qualities, Water activity of the considerable number of tests was resolved utilizing Novasina Lab Swift Water Activity meter.

Determination of Colour

Color is the most vital trait, aside from item appearance, that will decide the level of acknowledgment by buyers. The color of the dried samples was determined using Color Quest XE Hunter Color Meter, in light of the L* a* b*. L* represents the lightness on a 0 – 100 scale from black to white while a* and b* denote the hues which represent two colour axes with a* denoting redness (+) or greenness (–) and b* denoting yellowness (+) or blueness (–). The equipment was calibrated using a white tile and the samples were measured in three replicates and the average was reported.

pH Determination

pH of fresh, freeze and hot air dried meat extract was determined by blending 10 g of sample with 50 ml of distilled water for 1 min using a tissue homogenizer at 8000 rpm for 1 min. The pH of the suspension was recorded by dipping combined glass electrode of digital pH meter Systronic 335. Trout et al[11]

Determination of Anti-Oxidant Activity –DPPH Assay

Antioxidant activity was determined by DPPH assay as described by Sarker et al [12]. 0.5g of sample was extracted with 10ml of 80% ethanol in a water bath for 3 hours at 45°C. The samples were then centrifuged at 5000rpm for 5min and the supernatant was separated. Varying concentrations of the sample were taken into tubes. 0.004% of DPPH solution was made and 6ml of this solution was added to each of the tubes. The tubes were incubated in dark for 30min and the OD at 517nm was taken.

$$\%\ \text{Radical Scavenging activity} = \frac{\text{Absorbance of Control} - \text{Absorbance of Sample}}{\text{Absorbance of Controle}} * 100 \quad \ldots\ldots(8)$$

Determination of Total Phenolic Content

Total phenolics were analysed spectrophotometrically using the modified Folin–Ciocalteu colorimetric method as described by Ching Hui chang et al [13]. Ethanolic solution of the extract in the concentration of 1 mg/ml was used in the analysis. The reaction mixture was prepared by mixing 0.5 ml of ethanolic solution of extract, 2.5 ml of 10% Folin-Ciocalteu's reagent dissolved in water and 2.5 ml 7.5% $NaHCO_3$. Blank was prepared, containing 0.5 ml methanol, 2.5 ml 10% Folin Ciocalteu's reagent dissolved in water and 2.5 ml of 7.5% of NaHCO3. The samples were thereafter incubated in a thermostat at 45˚C for 45 min. The absorbance was determined using spectrophotometer at 765 nm. The samples were prepared in triplicate for each analysis and the mean value of absorbance was obtained.

RESULT AND DISCUSSION

Drying of Meat Extract

The yield of the samples after tray and freeze drying were found to be:

- Tray dried sample-50ml of extract gave 12g of dry sample.
- Freeze dried sample-50ml of extract gave 8g of dry sample

The average time taken for tray drying of the goat leg extract was found to be 18 hours while that of freeze drying was found to be 5 days.

Physicochemical Properties of Dried Goat Leg Extract

Determination of Density Parameters of Dried Goat Leg Extract

Goat leg meat extract powder dried by freeze drying and hot air drying showed significant difference in bulk

density values. The density of the samples was found to vary linearly with moisture content. The results are tabulated in table 1 When compared with the two samples the freeze dried sample was found to have good flowability with 1.2±0.03 as hausner ratio and the Carr's index as 14.3±0.02.

Table 1
Density parameters of freeze and hot air dried sample

Sample	Bulk density(g/ml)	Tapped density(g/ml)	Hausner ratio(HR)	Carr's index(CI)
Freeze dried sample	0.4±0.01	0.11±0.04	1.2±0.03	14.3±0.02
Hot air dried sample	0.3±0.00	0.12±0.03	2.4±0.01	26±0.01

All values are expressed as mean±standard deviation of three replicates.

Determination of Rehydration and Water Absorption capacity of Dried Goat Leg Extract

Water absorption capacity is an index of starch gelatinization .The rehydration ratio and water absorption capacity of the freeze dried sample was found to be greater than the hot air dried sample which makes freeze dried foods more suitable for the production of ready to eat meals The water absorption capacity of Freeze dried sample was found to be 8.36± 0.03 g/g thus this temperature could retain a greater amount of water than samples dried at higher temperatures. Water absorption capacity and rehydration ratio were found to vary significantly with changes in temperature, thus indicating that temperature is a major factor affecting the 2 parameters. The results are tabulated in Table 2.

Table 2
RR, WAC, and solubility of freeze and hot air dried sample.

Sample	RR(g/g)	WAC(g/g)
Freeze Dried Goat Leg Extract	6.13±0.03	8.36±0.03
Tray Dried Dried Goat Leg Extract	5.01±0.02	6.36±0.02

All values are expressed as mean±standard deviation of three replicates.

Determination of Solubility of Dried Goat Leg Extract

Water solubility indicates the extent of starch degradation. A higher solubility was found in hot air dried samples as compared to the freeze-dried samples. This increase in the solubility can be attributed to the increased degradation during hot air drying. The solubility of the samples was found to vary significantly. The results are tabulated in Table 3.

Table 3
Solubility of freeze and hot air dried sample.

Sample	Solubility (%)
Freeze Dried Goat Leg Extract	5.34±0.01
Tray Dried Dried Goat Leg Extract	9.36±0.02

All values are expressed as mean±standard deviation of three replicates.

Determination of Colour for Dried Goat Leg Extract

Freeze drying results in lighter coloured samples as shown by the higher L values of the freeze-dried sample. The results indicated that freeze drying was found to prevent the occurrence of browning and produced high quality of freeze dried goat leg extract powder. The whiteness index (WI) represents the overall extent of discolouration of the samples and was found vary significantly with change in temperature. The results are tabulated in Table 4.

Table 4
Colour attributes of hot air and freeze dried sample

Sample	L*	a*	b*	dE*
Freeze Dried Goat Leg Extract	37.58±0.01	0.03± 0.003	5.47±0.05	56.54±0.005
Tray Dried Dried Goat Leg Extract	45.5±0.02	-1.39±0.01	4.73±0.03	48.5 ±0.02

All values are expressed as mean ± standard deviation of three replicates.

Total Phenolic Content

The total phenolic content was found to be 1.3mg/g for fresh meat samples. On subjecting to drying a reduction was observed for both methods of drying. The values were found to be as 0.815mg/g and 0.49 mg/g. A good phenolic content was found to be in freeze dried sample.

Antioxidant Activity

There was a high scavenging activity was found in fresh sample and on drying the tray and freeze dried sample had a low scavenging activity. The IC50 values were as in the Figure 1 & 2.

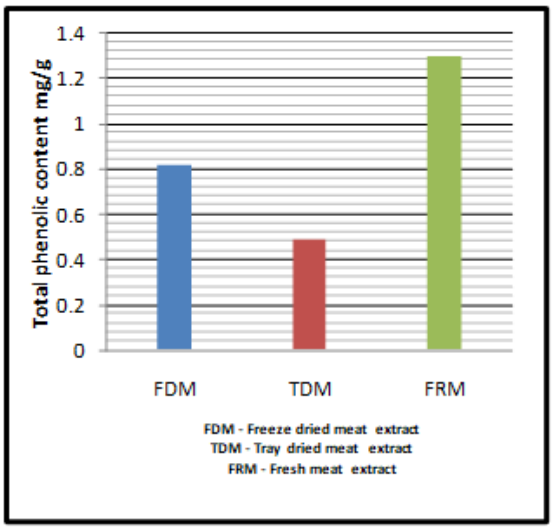

Figure 1
Comparison of Total phenolic content of dried with fresh sample

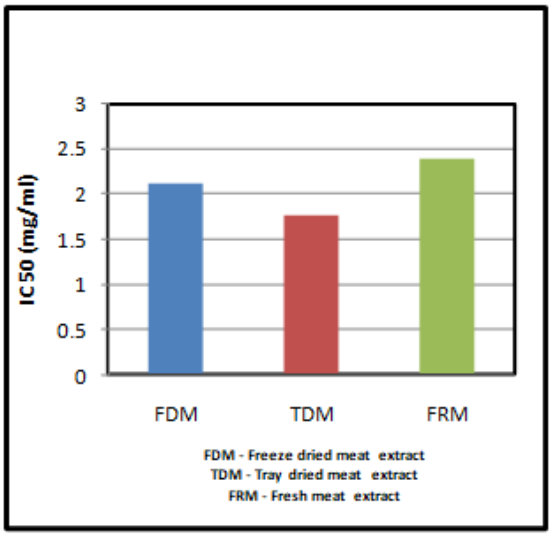

Figure 2
Comparison of IC_{50} of dried with fresh sample

CONCLUSIONS

Current findings revealed that freeze drying was the preferred method for drying of goat leg extract. On physicochemical properties both powder from two drying methods did not have much difference over the parameters. While on comparison freeze drying possessed better activity on comparison with hot air drying which may be because of low temperature drying. The rehydration ratio was found to be 6.13±0.03 which shows that it was be incorporated into other food products and easily soluble. Freeze drying resulted in concentration of the nutrients and may be used as a technique for the preservation and utilization of dried goat leg extract.

CONFLICT OF INTEREST

Conflict of interest declared none.

REFERENCES

1. Devendra C. Concluding synthesis and the future for sustainable goat production. Small Rumin Res. 2010 Apr 30;89(2):125-30.
2. Madruga MS, Bressan MC. Goat meats: Description, rational use, certification, processing and technological developments. Small Rumin Res. 2011 Jun 30;98(1):39-45.
3. Webb EC, Casey NH, Simela L. Goat meat quality. Small Rumin Res. 2005 Oct 31;60(1):153-66.
4. Cindy Micleu. Bone Broth For Health Building: Nourishing The Liver And Kidneys, Multiple Trellis Coded Modulation. 2015; p 781-2253
5. Elaveniya E, Jayamuthunagai J. Functional, physicochemical and anti-oxidant properties of dehydrated banana blossom powder and its incorporation in biscuits. Int J Chem tech Res. 2014;6:4446-54.

6. Jiang H, Adhikari B. Fruit and vegetable powders. In Handbook of Food Powders; Wood head Publishing: Sawston, UK. 2013; (13) p. 532–52.
7. Ratti C. Hot air and freeze-drying of high-value foods: a review. J Food Eng. 2001 Sep 30;49(4):311-9.
8. Rennard BO, Ertl RF, Gossman GL, Robbins RA, Rennard SI. Chicken soup inhibits neutrophil chemotaxis in vitro. Chest Journal. 2000 Oct 1;118(4):1150-7.
9. Lee CW, Oh HJ, Han SH, Lim SB. Effects of hot air and freeze drying methods on physicochemical properties of citrus 'hallabong' powders. Food Sci Biotechnol. 2012 Dec 1;21(6):1633-9.
10. Pervin S, Islam MS, Islam MN. Study on rehydration characteristics of dried lablab bean (Lablab purpureus) seeds. Journal of Agriculture & Rural Development. 2008;6(1):157-63.
11. Troutt ES, Hunt MC, Johnson DE, Claus JR, Kastner CL, Kropf DH, Stroda S. Chemical, physical, and sensory characterization of ground beef containing 5 to 30 percent fat. Journal of Food Science. 1992 Jan 1;57(1):25-9.
12. Sarker SD, Latif Z, Gray AI. Natural Products Isolation. Humana Press Inc, New Jersey, U.S.A. 2006; p. 20.
13. Chang CC, Yang MH, Wen HM, Chern JC. Estimation of total flavonoid content in propolis by two complementary colorimetric methods. J Food Drug Anal. 2002 Jul 1;10(3):178-82.

Reviewers of this article

Dr.V.Nithyalakshmi, Ph.D

Assistant Professor, Food Process Engineering, College of Food and Dairy Technology, Koduvalli,

Tamilnadu Veterinary And Animal Sciences University, Chennai-52

Prof.Dr.K.Suriaprabha

Asst. Editor , International Journal of Pharma and Bio sciences.

Prof. Srawan Kumar G.Y

Associate Professor,Nalanda Institute of Pharmaceutical Sciences, Sattenapalli, Guntur, Andrapradesh, India

Prof.P.Muthuprasanna

Managing Editor , International Journal of Pharma and Bio sciences.

We sincerely thank the above reviewers for peer reviewing the manuscript