IMPACT OF DRYING TECHNIQUES ON THE NUTRITIONAL COMPOSITION OF SPECIFIC MEAT VARITIES (BEEF, CHICKEN AND SHEEP)

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Abstract
Present study investigated the impact of sun-drying and oven drying methods on the nutritional composition of specific meat strips derived from chicken, beef, and sheep. The meat strips were subjected to oven drying at a temperature of 60°C for duration of 72 hours, and sun-drying was conducted at an average temperature of 34°C for a period of 120 hours until a stable weight was achieved. The findings of the proximate analysis revealed that, sun drying approach promotes 10-20% increase in protein accumulation across all meat samples. Additionally, the moisture content of the fresh samples is 30% greater compared to both the sun drying and oven drying samples. All of the dried samples exhibited a relatively low ash concentration, with the exception of the oven dried beef, which displayed a 2% increase compared to the fresh sample. The fat content of all the dried samples was dramatically reduced, with the exception of the sun-dried sample of sheep meat, which exhibited an increase. The sensory qualities, nutritional composition, and shelf life of the final products are significantly influenced by the drying method, as well as the temperature, humidity, and duration of the drying processes. The fresh samples (beef, chicken and sheep) showed higher ($p<0.05$) water absorption capacity, it was noticed that the carbohydrate content of dried chicken meat samples was lower (ranging from 1.19% to 3.96%) compared to the corresponding fresh samples. fat content of fresh chicken, sheep, and beef is 24%, 0.22%, and 8.00% and their ash content were 3.00%, 4.00%, and 9.00%, respectively

Keywords: drying methods, shell life, proximate analysis and temperature.

Introduction

The process of drying has been employed by human beings for numerous years as a time-honored technique for preserving food, with the primary objective of prolonging the longevity of diverse food items. The utilisation of drying techniques is of utmost importance in the preservation of meat, as it effectively reduces its moisture levels, therefore impeding the proliferation of bacteria and germs that contribute to spoiling (Hotchkiss & Potter, 1995). Furthermore, it is worth noting that the drying techniques employed can exert a notable influence on the nutritional makeup of the meat, hence providing advantages such as prolonged shelf life and enhanced mobility. Two often employed techniques for dehydrating meat include sun drying and oven drying (Ayanwale et al, 2007). These techniques not only facilitate the extraction of moisture from the meat but also have an effect on its nutritional makeup. It is necessary to comprehend the impact of different drying techniques on the nutritional composition of specific types of meat in order to assess their appropriateness for consumption and preservation (Macrae *et al*.,1997). The process of sun drying entails the deliberate exposure of meat to the natural sunshine over an extended duration, facilitating the progressive removal of moisture by the combined effects of heat and airflow (Ayanwale et al, 2007). In contrast, oven drying involves the application of regulated heat from either an oven or a dehydrator in order to expedite the process of moisture removal. Both methodologies possess distinct advantages and limits, and their influence on the nutritional composition of meat warrants significant deliberation. Numerous scholarly investigations have been conducted to examine the impact of sun drying and oven drying methods on the nutritional composition of beef. One study conducted by Onwuka *et al*. (2018) investigated the nutritional alterations in dried beef that underwent two different drying methods, namely sun drying and oven drying. The findings indicated that both approaches yielded substantial decreases in moisture levels, hence extending the duration of product viability.

Nevertheless, the research also revealed that the process of sun drying resulted in a more significant decrease in specific nutrients, such as vitamins B1 and C, in comparison to oven drying. Zhang *et al*. (2022) conducted a study to assess the nutritional alterations in dried pork through the utilization of sun drying and oven drying techniques. The results indicated that both approaches were successful in decreasing moisture levels and enhancing protein levels. Nevertheless, it was observed that sun drying led to greater reductions in specific important amino acids in comparison to oven drying.

These findings emphasize the significance of taking into account the distinct nutritional alterations that take place during the processes of sun drying and oven drying of beef. Both drying processes have advantages in terms of preserving the meat, but they can also result in nutrient losses depending on the specific drying circumstances and features of the meat. It is imperative for consumers, food makers, and researchers to comprehend the impact of various drying techniques on the nutritional makeup of meat. Through a comprehensive analysis and juxtaposition of the results obtained from the processes of sun drying and oven drying, individuals can make well-informed judgements pertaining to the manufacturing and consumption of dehydrated beef products that effectively satisfy nutritional needs and sensory inclinations.

This article aims to provide a thorough examination of the impact of sun drying and oven drying methods on the nutritional makeup of specific types of beef. Through the utilisation of pertinent studies and research findings, our objective is to offer a more comprehensive comprehension of the parallels, distinctions, and factors to be taken into account in relation to each drying technique. The acquisition of knowledge through this exploration will serve to enhance decision-making processes pertaining to the application of different drying techniques in the preservation and consumption of beef.

2.0 Materials and methods

A selection of freshly obtained specimens of chicken, beef, and sheep meat were procured from Sango, Kulende Market, located in Ilorin, Kwara State, Nigeria

2.1 Sample Preparation

The boneless beef cuts were gathered from several distribution sites at Sango Market in Ilorin, Kwara State, on the same days. The samples underwent a thorough washing process utilising clean water, followed by being chopped into small strips measuring 8cm x 5cm x 0.5cm in size. The strips were collectively weighed to create the necessary samples for the drying process, which involved utilising both sun drying and oven drying techniques.

2.2 Experimental Procedure

Sun drying: The samples of chicken, sheep, and beef were subjected to sun drying from 11:00 am to 4:00 pm over a period of three days. The dried meat materials were powdered and afterwards stored in an airtight containers for the purpose of proximate analysis.

Oven drying: Oven drying was conducted by employing an oven drier set at a temperature of 600°C for a duration of 72 hours. Subsequently, every sample was pulverised using a mortar and pestle, and subsequently preserved in a hermetically sealed container for the purpose of conducting proximate analysis.

This research was conducted during raining season

Proximate analysis: The proximate analysis involved doing both proximal and chemical analyses using the A.O.A.C (2000) methodology.

Hygroscopicity: The hygroscopicity of the substance was assessed using the methodology outlined by Bhatty (1988). Approximately 5.0 grammes of the meat specimen was subjected to the prevailing environmental conditions, including temperature and humidity. The hygroscopicity of the beef sample was quantified by calculating the percentage increase in weight after a 48-hour period of exposure

Sensory evaluation: In this study, a sensory evaluation was conducted on fresh and dried beef samples. The evaluation encompassed many attributes including colour, appearance, scent, texture, and general acceptability. A 5-point descriptive hedonic scale, as outlined by Ihenkoronye and Hgoddy (1985), was utilised for rating the items. The scale ranged from 5 (indicating high quality) to 1 (representing low quality). A panel consisting of 10 judges, who were selected randomly from a pool of students within the department, was formed for the purpose of evaluation. The presentation order of the meat samples to the judges was randomised, and a coding system was employed to conceal the identity of the samples.

RESULTS AND DISCUSSION

Table 1: Drying Rate and Weight Loss of Sun Drying and oven drying method

	Sun Drying method					***Oven Drying method***				
Sample	**WI**	**WF**	**T**	**DR**	**WL**	**WI**	**WF**	**T**	**DR**	**WL**
DAY 1										
Sample A	20.38	14.76	60	0.094	0.276	82.16	43.16	60	0.650	0.475
Sample *B*	33.62	20.76	60	0.214	0.383	63.05	33.41	60	0.494	0.470
Sample *C*	33.78	21.09	60	0.212	0.376	59.38	37.39	60	0.367	0.370
DAY 2										
Sample A	13.81	11.49	60	0.039	0.168	42.65	22.25	60	0.340	0.478
Sample B	18.37	13.85	60	0.075	0.246	35.93	18.92	60	0.284	0.473
Sample C	18.25	14.49	60	0.063	0.206	32.83	19.08	60	0.229	0.419
DAY 3										
Sample A	11.32	10.00	60	0.022	0.117	22.27	20.00	60	0.038	0.102
Sample B	13.42	10.67	60	0.046	0.205	19.00	15.69	60	0.055	0.174
Sample C	14.13	11.37	60	0.046	0.195	18.79	15.00	60	0.063	0.202

Note: sample A,B and C = Chicken, Beef and Sheep respectively .WI = Initial Weight (g), WF = Final Weight (g), T = Time Taken (min.), DR = Drying Rate (g/hr.), WL = Weight Loss (g)

Drying rate: table 1 shows the effect of drying methods on the drying rate of different meat samples. It can be seen from the table 1 that the rate of oven drying higher than that of sun drying and this may be attributed to high and constant temperature of oven dry methods at 60^{0}C. at day one the rate evaporation was high (> 47%)and consistent till day two in sample A and Sample B but drastically reduced on day three to about 10.19 and 17.42%, in sample A and B and this may be attributed to reduction of moisture content of the samples after day two (Adeyi *et al*, 2015). inconsistent rate of evaporation was noticed in sample C

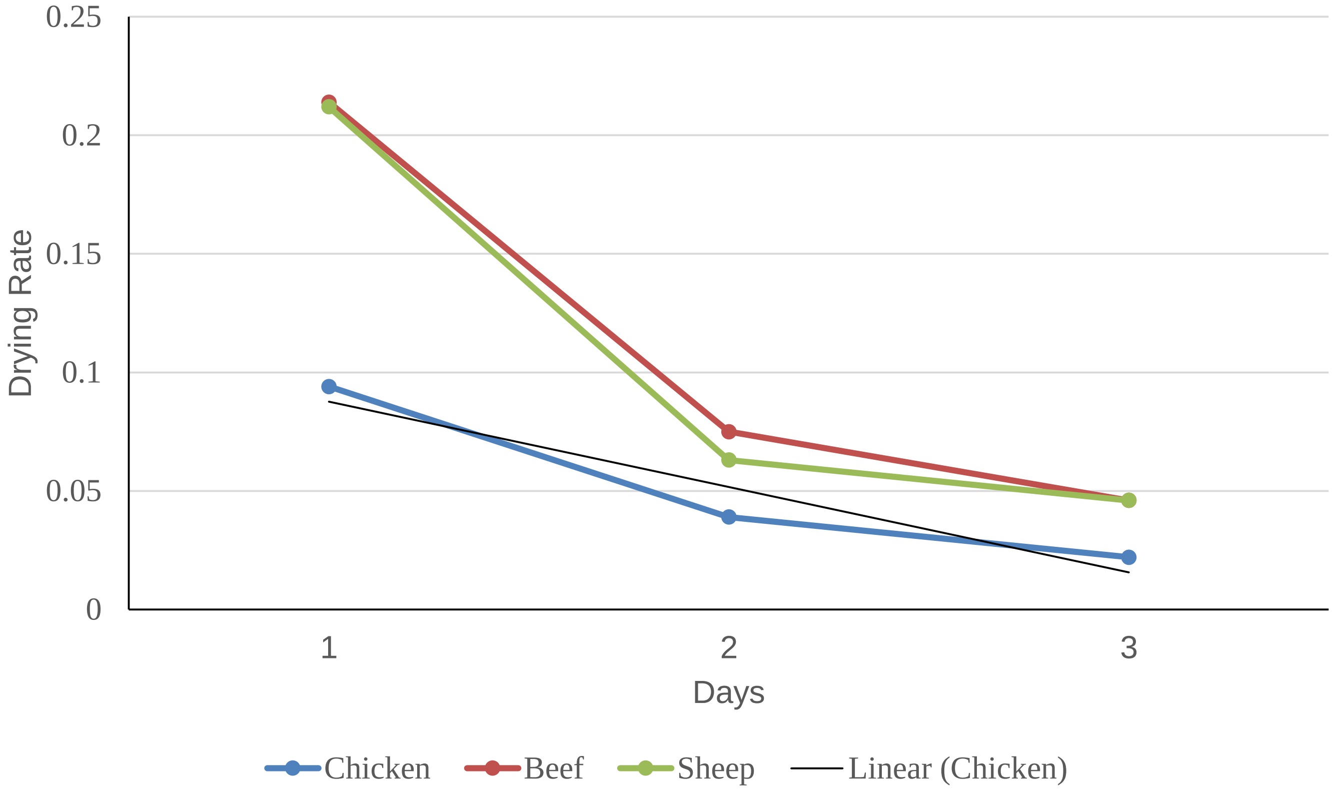

Figure 1: Graph of Drying Rate against Days for Chicken, Beef and Sheep under Sun Drying method for Day 1 to Day 3

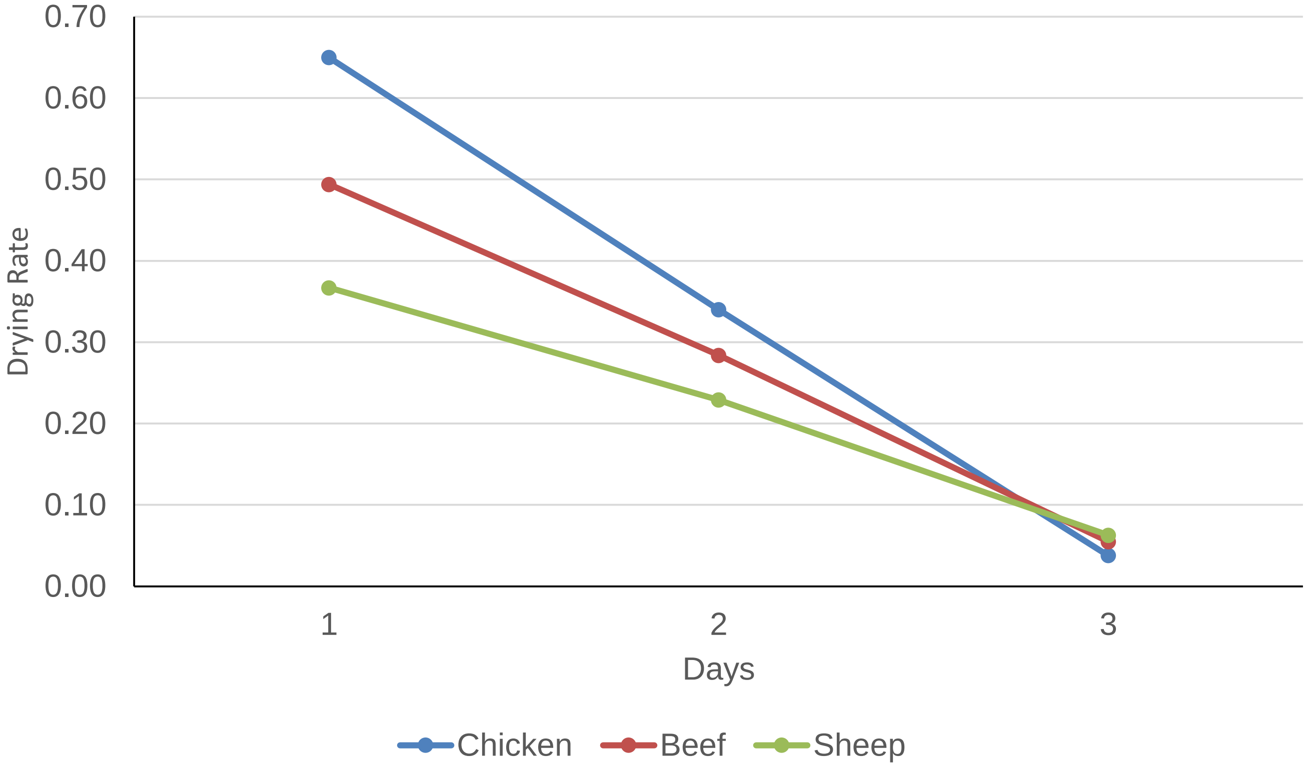

Figure 2: Graph of Drying Rate against Days for Drying Chicken, Beef and Sheep under Oven Drying method for Day 1 to Day 3

Determination of Proximate Composition

Table 2: Proximate Analysis

Sample	Moisture Content (%)	Ash Content (%)	Fat (%)	Protein (%)	Fibre (%)	Carbohydrate (%)
		Chicken				
Fresh	60.00	4.50	24.00	65.96	0.98	3.96
Sun Drying	37.95	2.20	2.00	76.29	0.80	1.19
Oven Drying	37.30	3.00	5.00	73.24	0.84	1.19
		Sheep				
Sample	**Moisture Content (%)**	**Ash Content (%)**	**Fat (%)**	**Protein (%)**	**Fibre (%)**	**Carbohydrate (%)**
Fresh	65.00	2.40	0.22	25.62	2.77	0.31
Sun Drying	33.92	0.51	9.00	38.95	2.87	0.85
Oven Drying	10.90	4.00	0.31	42.61	2.85	0.60
		Beef				
Sample	**Moisture Content (%)**	**Ash Content (%)**	**Fat (%)**	**Protein (%)**	**Fibre (%)**	**Carbohydrate (%)**
Fresh	71.00	7.50	8.00	60.92	3.98	0.81
Sun Drying	45.00	1.00	5.00	82.34	4.25	1.37
Oven Drying	41.61	9.00	2.00	77.40	4.22	1.34

The proximate analysis results of fresh, sun drying and oven drying of sample A, B and C are shown in table 2. The examination of the impact of sun drying and oven drying methods on the nutritional composition of chicken, beef, and sheep meat demonstrated numerous noteworthy distinctions

Moisture content: it can be seen from table 2 that the moisture contents of freshly prepared of all the samples (ABC) were ranged between 60% to 75% which is considered high and instigate microbial activities and reduce the shelf life of the meat (Okonkwo, 1984). The oven drying method showed the lowest moisture content of 37.3%, 10.90% and 41.61% for sample A, B and C respectively. This might due to maintenance of temperature at 60^0C and lead to extension of shelf life since spoilage organism can no longer g row or proliferate in the absence of moisture content (leroy *et al*, 2006; Lawrie and Ledward, 2006).

Protein content: The protein content of the meat samples was generally higher when subjected to sun drying in comparison to oven drying and fresh meat. The higher protein retention seen in this case may be related to the extended length of sun drying. These findings are consistent with the study conducted by Ayanwale *et al*. (2007), which reported that sun-dried samples exhibited higher protein content and lower fat content compared to meat that was dried in an oven. It is worth noting that chicken meat exhibits a higher protein content in comparison to beef and sheep meat. The crude protein values obtained for beef, sheep meat, and goat in this investigation exhibited a close proximity to the value reported by Norman (2004).

Ash Content: The ash content of the meat was variably influenced by the different drying processes employed. The process of oven drying often yielded elevated concentrations of important minerals, such as iron, zinc, and calcium, in comparison to sun drying. Shilton, 2003. The ash contents of the oven-dried samples A, B, and C were observed to be 3.00%, 4.00%, and 9.00%, respectively. The observed values exhibit a significant increase when compared to the values obtained from fresh and sun-dried samples. The ash level of beef was found to be consistent with the results reported by Adeyi et al. (2015). Furthermore, it is evident that the ash content of beef is comparatively larger when compared to that of sheep and chicken. This phenomenon might potentially be attributed to factors such as chronological age, dietary diversity, and environmental factors (Okezie and Bello, 1998).

Crude Fibre: The analysis of crude fibre content, as presented in Table 2, indicates that beef exhibits the highest fibre content, followed by sheep, while the lowest fibre level was observed in the chicken sample. Nevertheless, the preservation methods exhibit minimal disparity in fibre concentration when compared to the fresh sample. The modest rise in the proportion of crude fibre in the dehydrated meat product suggests that the amount of undigestible material in the product is minimal. This can be attributed to the effective breakdown of protein through the reduction of moisture content in the meat and subsequent moderate roasting over a glowing fire following the drying process (Adeyi et al., 2015).

Fat Content: The fat content of fresh chicken, sheep, and beef is 24%, 0.22%, and 8.00%, respectively. The fat content of the samples significantly decreases when exposed to preservation methods, potentially due to elevated temperatures during oven and sun drying processes, resulting in the fat melting from the samples. However, it was observed that the fat content of sun-dried samples of sheep was comparatively larger when compared to both fresh and oven-dried samples. This finding diverges from the observations made by Adeyi et al. (2015), who noted that high energy levels in human nutrition can likewise enhance its flavour.

Carbohydrate: Based on the findings shown in Table 2, it was noticed that the carbohydrate content of dried chicken meat samples was lower (ranging from 1.19% to 3.96%) compared to the corresponding fresh samples. Conversely, the carbohydrate content of dried sheep and beef meat samples was higher than that of their respective fresh samples. The higher ($p<0.05$) water absorption capacity of fresh samples of chicken, beef and sheep could be attributable to the high carbohydrate content of the fresh samples, which normally results in greater starch swelling. It could also be due to lesser structural change in the starch and proteins present in the beef samples. A microscopic analysis of dried beef sample has indicated that the size and shape of the starch granules as wasll as the distribution of the protein clusters had a substantial effect on the water absorption capacity (WAC) (Muir et al., 2000). The increased WAC values for the fresh samples could possibly be attributable to the bigger pores gaps in its structure than that of the dried sample.

Conclusion

The results of this study indicate that the nutritious value of chicken, beef, and sheep meat is influenced differently by sun drying and oven drying methods. The utilization of sun drying demonstrates a greater advantage in terms of preserving protein content and mineral composition, in contrast to oven drying which results in elevated fat levels. Nevertheless, it is crucial to take into account the potential hazards linked to the process of sun drying, including the possibility of contamination and the degradation of nutrients resulting from prolonged exposure to sunshine and various environmental conditions.

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