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Development and cost-benefit ratio of buffalo meat nuggets enriched with wheat bran

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Abstract
The purpose of this study was to standardise the processing methodology for buffalo meat nuggets with wheat bran and to assess the cost of producing the final developed product.

To assess the economics of buffalo meat nuggets, three treatments were developed by incorporating 5% wheat bran (T_1), 10% wheat bran (T_2), and 15% wheat bran (T_3) into products by replacing an equal proportion of buffalo meat from the formulation.

To prepare the product, both the treatment and control groups were steam cooked for 34 minutes. In cost economics, group T_2 had the highest cost of formulation. The break-even point was predicted to be Rs 720743.31 for the control, Rs 834937.62, Rs 1012066.39, and Rs 1268232.96 for T1, T2, and T3, correspondingly. The cost-benefit ratio was highest for control and lowest for T3. The estimated economic specifics of the developed product revealed that an affordable firm may be established by maintaining a rate of Rs 249.79 for control and Rs 278.19, Rs 305.23, and Rs 224.08 for 5%, 10%, and 15% wheat bran incorporated items, respectively.

Keywords: Break-even point, wheat bran, cost benefit ration

Introduction
Meat is the main source of protein and has a high nutritional value for humans. Every year, the global consumption of meat (beef, chicken, pork, and lamb) is increasing (De Smet and Vossen, 2016; Shi *et al*., 2021) [4, 7]. Export of buffalo meat from India has registered a commendable rise during the past 2 decades and the liberalization policies seem to have further augmented its growth. India has competitive advantage in the export of buffalo meat, and long-term sustainability of buffalo meat export seems to be plausible. In recent years, consumer food preferences have dramatically shifted, favoring ready-to-eat, fresh, minimally processed, and greater nutrient meat products with original color, texture, and flavor. Meat produced from buffaloes has gained increased popularity in several south eastern and middle-eastern Asian countries and Africa because of its reduced fat, reduced cholesterol, and other healthier attributes. Meat is specifically valuable as a source of omega-3 fatty acids, vitamin B_{12}, protein and highly bioavailable iron (Bender, 1992; Magar, 2022) [2, 5]. Additionally, buffalo meat is rich in vitamins B_{12} and B_6, zinc, and selenium, making it a valuable dietary component, especially in regions where access to diverse protein sources is limited (Soren and Biswas, 2020) [3]. In India, ready-to-eat meat products are gaining popularity in recent years, and value-added food products with healthier alternatives are being introduced in the market to explore their potential in terms of consumer preference ((Soren and Biswas, 2020) [3]. Development of processed meat products involves the incorporation of non-meat ingredients or additives for enhancing the quality attributes, sensory profile and shelf life (Das *et al*., 2020) [3]. Among the value-added meat products, sausages, burger patties, nuggets, and other emulsion-based meat products are very popular worldwide (Ravani and Sharma, 2022) [6]. Nuggets are one of the most acceptable value-added comminuted emulsion-based products that are either baked, steam-cooked, or consumed after frying (Bansil, 2003) [1].

Material and Methods

Preparation of buffalo meat nuggets: Frozen buffalo meat was partially thawed overnight, then chopped into small cubes and double minced using a meat mincer. Meat emulsion was made in a bowl chopper (Hakimi, India). A pre-weighed amount of minced buffalo meat, salt, sodium tripolyphosphate, and sodium nitrite were combined and chopped for approximately 2-3 minutes. It was chopped for another 2 minutes after adding the ice flakes. Oil was gradually mixed into the paste while cutting, until it was evenly distributed throughout. Wheat bran, condiment paste, dry spice mix, and additional components such as refined wheat flour, egg albumin and sugar were added. Chopping was continued until all of the ingredients were uniformly dispersed and the emulsion had the appropriate consistency. A weighed quantity of emulsion was used to fill a stainless steel mould. The mould was covered with a lid, fastened with thread, and steam cooked for 34 minutes. A probe thermometer was used to measure the core temperature of cooked blocks, which should be around 73 °C. Buffalo meat block was sliced, chopped into nuggets, and refrigerated at 4 °C. At 7-day intervals, samples were extracted for microbiological investigation. The analysis lasted 7, 14, 21, and 28 days in refrigeration storage at 4 °C.

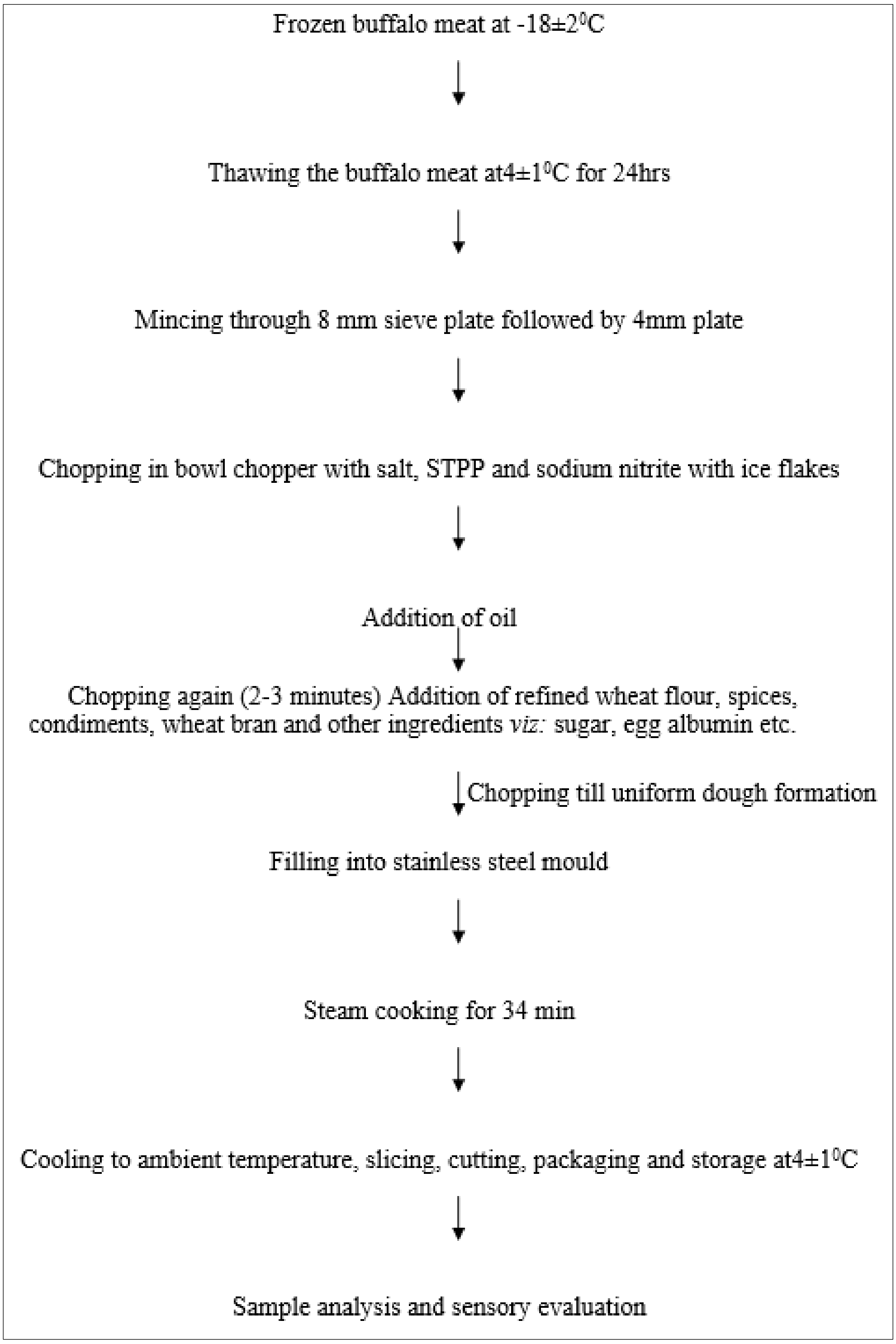

Fig 1: Flowdiagram for preparation of buffalo meat nuggets

Formulas used during the assessment of product economics

Production costs for 100 kg of buffalo meat nuggets are equal to the formulation costs + production overhead.

The cost of overhead production is equal to the sum of the following: daily depreciation, building rent, labour, electricity, maintenance, water, and packaging costs.

The price of 1 kg of buffalo meat nuggets is calculated by dividing the formulation cost of 100 kg by the cooking yield.

Income=total sale price – total cost of production

Fixed cost × Total sales/Total sales − Variable cost is the break-even point. Total profit divided by total manufacturing costs is the cost-benefit ratio.

Net profit per day is calculated by subtracting the daily loan payment amount from the total profit.

Results and Discussion

Table 1 shows the spice mixture used in preparation of buffalo meat nuggets. Table 2 lists the equipment costs needed for this research, and using a 10% annual rate of depreciation, their yearly depreciation was determined to be Rs3, 28, 80 as shown in Table 3.

Table 1: Spice mix used in preparation of buffalo meat nuggets

Sl. No.	Ingredients	Percentinmix
1	Aniseed(Soanf)	14
2	Blackpepper(Kalimirch)	13
3	Capsicum(Mirch powder)	14
4	Mace (Javitri)	0.5
5	Cardamom(BadaElaichi)	4
6	Cinnamon(DalChini)	5
7	Cloves (Laung)	5
8	Coriander powder (Dhaniya)	21
9	Cumin(Jeera)	10
10	Turmeric(Haldi powder)	4
11	Nutmeg(Jaiphal)	0.5
12	Driedginger powder	9
	Total	100

Table 2: Fixed expenditure (Equipments) for Buffalo meat nuggets

Equipments	Price (in rupee)
Meat mincer	72,000
Steam cooker	11,000
Refrigerator	27,000
Deepfreezer	43,000
Bowl chopper	1,50,000
Balance	1800
Furniture	7000
Grinder	5000
Packaging machine	4000
Miscellaneous	8000
Total fixed expenditure	₹3,28,800

Table 3 listed the overhead production costs for a 100 kg product, which comprise daily depreciation costs, building rent per day, labour expenses, maintenance costs, electricity cost, water charges, and packaging costs.

Table 3: Overhead production cost of 100 kg buffalo meat nuggets

S. No.	Item	Cost
1	Annual depreciation Daily depreciation cost	@ 10% =Rs. 3, 28, 80 / annum @ 25 working day/month = Rs. 109.6/day
2	Rent of building Rent per day	3800 /month @ 25 working day/month = Rs.152/day
3	Labourcost:- Trained labour @ Rs Untrained labour@	@Rs. 400X2 =Rs. 800 /day @Rs. 300X3= Rs900/day Total= Rs1700/day
4	Electricity cost	45unit@9.00/Unit= Rs405/day
5	Maintenance	Rs 150/day
6	Water charge (approx)	Rs 40/day
7	Cost of packaging (400 packet @ Rs.1.75/packet)	Rs700/day
Total		3256.6/day

The formulation cost for each of the product groups shown in Table 4 was computed for a 100 kg product. The production cost of a 100 kg product for the control group was determined to be Rs 17074.5. The production costs for the T_1, T_2, and T_3 groups were Rs19924.5, Rs22774.5, and Rs25624.5, respectively.

Table 4: Formulationcostfor100kgBuffalo meat nuggets

Ingredients	(inrupees)			
	C(₹)	T_1(₹)	T_2(₹)	T_3(₹)
Meat (72%,67%,62%,57%)	12960	12060	11160	10260
Refined sunflower oil (Fortune)(7%)	1190	1190	1190	1190
Ice (10%)	40	40	40	40
Salt (1%)	28	28	28	28
SodiumNitrite (.02%)	4	4	4	4
STPP(.5%)	350	350	350	350
Condiment(2.5%)	140	140	140	140
Sugar(0.5%)	22.5	22.5	22.5	22.5
Wheat bran (0%,5%,10%,15%)	-	3750	7500	11250
Refined wheat flour (Maida) (3%)	270	270	270	270
Egg albumin (1.48%)	1110	1110	1110	1110
Spice Mix (2%)	960	960	960	960
Total	17074.5	19924.5	22774.5	25624.5

Per day expenditure cost for 100 kg product was calculated for all the treated and control group are presented in Table 5. It was estimated that per day expenditure cost for the control group was Rs20331.1 and wheat bran treated groups, i.e. for T_1, T_2, and T_3 were Rs23181.1, Rs26031.1and Rs28881.1 respectively.

Table 5: Per day expenditure for 100 kg Buffalo meat nuggets

Groups	C(Rs)	T_1(Rs)	T_2(Rs)	T_3(Rs)
Rent	152	152	152	152
Depreciation	109.6	109.6	109.6	109.6
Labor charge	1700	1700	1700	1700
Electricity	405	405	405	405
Maintenance	150	150	150	150
Water charge	40	40	40	40
Packaging	700	700	700	700
Totalcostofproductionfor 100 kg formulation	20331.1	23181.1	26031.1	28881.1
Cooking yield product	90.73	92.80	93.57	94.62
Ratefor 1 Kg formulation	224.08	249.79	278.19	305.23

Profit @35 =106.83
MRP on the product= ₹ 412.06

Table 6: Income and total profit from control and wheat bran incorporated buffalo meat nuggets

Groups	C(₹)	T_1(₹)	T_2(₹)	T_3(₹)
Income/Kg	187.98	162.27	133.87	106.83
Income/100Kg	18798	16227	13387	10683
Total profit/day	18798	16227	13387	10683

The total profit and income from product sales for each of the product groups shown in Table 6 was around Rs18798 per day for the control group, Rs16227 per day, Rs13387 per day, and Rs10683 per day for the T_1, T_2, and T_3 groups, respectively.

Table 7: Calculation of variable cost and total project cost for control and wheat bran incorporated buffalo meat nuggets

Groups	Fixed cost (₹)	Variable cost (₹)	Totalprojectcost(₹)
C	3,28,800	20331.1	349131.1
T_1	3,28,800	23181.1	351981.1
T_2	3,28,800	26031.1	354831.1
T_3	3,28,800	28881.1	357681.1

Total project cost=₹400000 Loan amount = ₹ 340000
Margin money = ₹ 60,000
Amount of interest@12%/annum=₹40,800
Amount of loan payment/month=3400(for12months only)
Amount of loan payment/day =₹ 136

By adding up the fixed and variable costs in Table 7, the product's total project cost was determined to be Rs349131.1, Rs351981.1, Rs354831.1, and Rs357681.1 for the control, T_1, T_2, and T_3 groups, respectively.

Table 8: Net profit/day after payment of loan control and wheat bran incorporated buffalo meat nuggets

Group	Total sales/day(₹)	Variable Cost(₹)	Total cost of production/day(₹)	Net profit/day (Afterpaymentof loan 136/day) (₹)
C	41206	22408	22408	18662
T_1	41206	24979	24979	16091
T_2	41206	27819	27819	13251
T_3	41206	30523	30523	10547

Table 9: Calculation of break even point and cost benefit ratio for control and wheat bran incorporated buffalo meat nuggets

Group	Break Even Point	Cost benefit ratio
C	3,28,800×41206/41206-22408= 720743.31	18798/22408=0.838or 84%
T_1	3,28,800×41206/41206-24979= 834937.62	16227/24979=0.649 or 65%
T_2	3,28,800×41206/41206-27819= 1012066.39	13387/27819=0.481or 48%
T_3	3,28,800×41206/41206-30523= 1268232.96	10683/30523=0.349or 35%

Table 9 shows the estimated break-even points for the control and wheat bran treated group, which were about Rs720743.31 for the control group, Rs834937.62, Rs1012066.39, and Rs1268232.96 for the T_1, T_2, and T_3groups, respectively. Because they had the lowest formulation costs, the control and T_1 groups had the highest cost-benefit ratio. A total of ₹ 249.79 for $T_{1,}$ ₹ 278.19 for T_2, ₹ 305.23for T_3 and ₹ 224.08 for control were spent on producing 1 kg of buffalo meat nuggets. The study suggests that entrepreneurs' invention and application of technology as a liveness proposal for lucrative speculation has a lot of potential to create jobs.

The overall cost for the production of 1 kg of buffalo meat nuggets incorporated with wheat bran was Rs 249.79 for $T_{1,}$ Rs 278.19 for T_2, Rs 305.23for T_3 and Rs 224.08 for control.

Conclusion

Buffalo meat nuggets enriched with wheat bran present a promising option for healthier, value-added meat products. While production costs increase with higher bran incorporation, consumer demand for nutritious, ready-to-eat options supports their market potential. The control and T1 groups showed the highest profit margins and cost-benefit ratios, indicating better economic viability. This study highlights the potential of buffalo meat processing for entrepreneurship, job creation, and meeting evolving dietary preferences, particularly in regions with limited protein diversity.

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