EFFECTS OF DIFFERENT TYPES OF DRYING ON THE NUTRITIVE VALUE OF PROTEINS IN THE FISHMEALS

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[A comparative study on the effect of different types of drying on the nutritive value of the proteins in the different fishmeals of known history was made. From the observations, it is clear that the mode of drying has got little or no effect on the nutritive value of the meal as revealed by the chemical indices of available lysine and pepsin digestibility, provided enough precautions were taken to avoid scorching during drying process. Sun dried meals are in no way inferior to the meals prepared by hot - air, steam or vacunm drying.]

INTRODUCTION

Fishmeals are highly valued in the cattle and poultry nutrition as they contain good quality and easily digestible proteins, vitamins and essential amino acids. Extensive studies on the nutritive value of herring meal were done by Bisset and Tarr (Bisset *et. al.* 1954); Trrr, Biely and March (Tarr *et. al.* 1954); Biely, March and Tarr (Biely *et. al.* 1955); Lea, Parr and Carpenter (Lea *et. al.* 1958 and 1960); Carpenter, Morgan, Lea and Parr (Carpenter *et. al.* 1962); Carpenter, Lea and Parr (Carpedter *et. al*. 1963) and March, Biely and Tarr (March *et. al.* 1963) Laksesvela (1958) has mentioned that the available lysine is a guide to the heat damage in the fishmeals. Carpenter and Ellinger (Carpenter *et. al.* 1955) found a significant correlation between the available lysine and gross protein value. March, Biely and Young (March *et. al.* 1950) found that the digestibility alone is not a good index for the nutritive value of the meals. Much of the damage to the heated proteins has been ascribed to the Maillard type of of reaction in which the amino groups of the lysine are combined with the carbonyl groups to form enzyme resistant complexes which impairs the nutritive value of the proteins. Sawant and Magar (1961) studied the changes in the nutritive value of Bombay Duck during processing and found that the retention of amino acids was higher during vacuum drying.

In tropical countries where solar energy is utilised for drying fish and sardine presscake a study on the effect of sun-drying in relation to other types of drying is of interest. Tar *et. al.* (1954) described the meals dried at low temperatures as 'ideal', while June Olley and Watson (June Olley *et. al.* 1961) mentioned that the low temperature drying in general produces meals of higher quality than does high temperature drying. Negi and Kehar (Negi *et. al.* 1962) reported that the beach dried 'Manthal meal' is superior to the meal processed by cooking and drying in the overall nutritive value. Work on the nutrltive value of fishmeal in India is limited to the proximate chemical composition. An attempt has been made to study the effect of different types of drying on the nutritive value of the proteins and the results are given in this paper.

Materials and methods

The fish utilised in the experiments were collected from the Offshore catches at Cochin. The fish were immediately utilised for the preparation of the meals. The meals were prepared by the Wet Reduction process as described by Kamasastri and Rao (In Press). The presscake was dried in the sun at a mean temperature of 33°C during a time interval of 18 to 24 hours. The presscake from the same lot was dried in vacuum at a temperature of 75°C and thermostatically controlled tunnel dryer at 45°C and 70°C; in hot air at 105°C and in the Rotary steam drier at 118°C during a time interval of 2, 12, 6, 4, and 3 hours respectively; to a moisture level below 10%. During the drying process the presscake was turned from time to time to avoid scorching. The dried material was pulverised and seived through 50 mesh seive before they were analysed.

The proteins and pepsin digestible nitrogen were determined by the A.O.A.C. methods (1960). The alpha amino nitrogen was dutermined by the Pope and Stevens method (1939). Available lysine was determinsd by the Carpenter's method (1960). Gross energy values were determined by chromic acid oxidation method of Shea and Maguire (1962). The gross protein value was calculated by the Anwar's formula (1962). The total volatile nitrogen was determined by the method of Conway and Byrene (1933).

Results and discussion

The proximate analysis showed that the protein value in the different meals ranged from 56.01% to 70.73% with an ash content ranging from 13.71% to 26.98% and negligible sand contents. The fat content in the different samples varied from 4.5% to 13.67%. The detailed results for the pepsin digestibility, available lysine, gross energy values and gross protein values of the samples dried at different tempeatures are shown in the table. Hitherto the nutritive value is represented by the amino-acid composition, vitamins and other unidentified growth factors. But with the recent advances in nutrition and chemistry of ptoteins the above values are also taken in predicting the nutritive value of the proteins in addition to the feed tests.

It can be seen from the table that the moisture content and total volatile nitrogen of the meals dried in the sun and tunnel are slightly higher than the meals dried by other means. The amino nitrogen is nearly the same in the different methods of drying. This clearly shows that the decomposition during the drying process is not quite pronounced.

Wilmer (1957) found that meals, dried in flame driers are having a high digestibility compared to the steam dried meals. Hiroshi Kawata et. al.(1955) observed low pepsin digestibility in herring and sardine meals. Similar low values of the pepsin digestibility were observed by the present authors in the sardine meals. From the table it is seen that the digestibility of the vacuum dried meals are generally more but the notable feature is that the meals dried in the sun showed an equal digestibility as that of the vacuum dried meals. It is also noteworthy that the pepsin digestibility of the different meals dried by different methods showed very little change. These observations are in agreement with Stansby (1963). June Olley and Watson (196I) observed that the pepsin digestibility of more than 89% is assotiated with the available lysine content ranging from 5.0 to 7.5 gms/16 gms. of nitrogen.

Tarr (1953) elucidated that ribose plays a greater part in Maillard reaction where the lysine is being affected. As the meals in our present study are prapared by the wet reduction process, a good part of the soluble carbohydrates are lost along with the stick water and as such sugars entering browning reaction is limited. Carpenter *et. al.* (1962) conclued that free and combined sugars present in the herring presscake can only make a minor contribution to the major losses of available amino acids that result from severe overheating. The available lysine values in the different meals varied from 6.24 to 7.8 gms/16 gms. of nitrogen. Similar high range of values were recorded by Carpenter (1960) in the case of herring meals. In the mojority of the sun dried meals the available lysine is equal if not more than the meals dried in vacuum. The loss in available lysine during hot-air drying in the different meals ranged from 0.52 to 3% with an exception of 5.0% in one sample.

There occurs ample opportunity for fat oxidation during sun drying compared to other types of drying. The unoxidised lipids present in the meals play no part in lysine binding reaction (Carpenter *et. al.* 1962). The role of oxidised lipids in determining the fate of available lysine is under investigation. Lea, Parr and Carpenter (1960) observed a loss of 8% available lysine in the case of control and 4% loss in the case of antioxidant treated herring meals during storage in air at 20°C for a period of 12 months. Carpenter *et.al.* (I962) observed that binding of amino acids was more at a moisture range from 5 to 14% on the fat free basis and the binding rapidly falls at low moisture levels.

Potter *et. al.* (1962) determined the gross energy values of the herring meals to evaluate the metabolisable energy which is also being utilised for nutritional evaluation. The gross energy values for the different meals ranged between 3.57 and 4.46 k.cals/gm. Potter recorded a higher range of values between 4.74 and 5.15 k. cals/gm.

The gross protein value of the different meals showed a range of 113.2 to 131.9

Almquist *et al.* (1935), Hastings (1951), Boyne *et. al* (1961) and Barnes *et.al.* (1963) used the protein quality index which is a measure of digestibility, extent of autolysis, hydrolysis and natural distribution in the nutritional evaluation of fishmeals and other feedstuffs. The protein quality index of the sun dried meals is nearly equal to the hot air dried meals where the period of drying is less (unpublished work).

From the above results it can be seen that the sundried meals prepared by wet reduction process are in no way inferior, in the nutritional quality, to the meals dried by hot air or steam dried or or vacuum dried as determined by chemical methods. However, high bacterial count was observed in the case of sun dried meals compared to heat processed meals.

SUMMARY

From the above studies it can be inferred that the mode of drying has got little or no effect on the nutritive value of the meal as revealed by the chemical indices of available lysine and pepsin digestibility provided enough precautions were taken to aviod scorching during process. Sun dried meals are in no way inferior to the meals prepared by hot air, steam or vacuum drying.

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TABLE - I EFFECT OF DIFFERENT TYPES OF DRYING ON THE NUTRITIVE VALUE OF FISH PROTEINS

Sl. No.	Type of fish from which the meals were prepared	Drying temperature °C	Mode of drying	Moisture %	Total Volatile N_2 mg %	Alpha amino N_2 mg %	Pepsin digestibility %	Available lysine value gms/16gms of N_2	Gross energy value K. Cal/gm.	Gross protein value
				(DRY BASIS						)
1.	Sardinella longiceps	33	Sun	7.99	24.44	117.2	93.61	7.09	4.28	122.4
		105	Hot-air	5.04	21.00	115.4	92.74	6.78	4.20	118.8
		75	Vacuum	5.98	19.25	110.3	94.01	6.99	4.12	121.3
2.	Neipterus japonicus	33	Sun	9.88	52.49	55.99	94.91	6.31	3.57	118.3
		105	Hot-air	8.72	48 99	59.48	94.86	6.24	3.64	112.5
		75	Vacuum	7.79	48.99	57.82	94.39	6.59	3.82	116.6
3.	Polpnemus sexfilis	33	Sun	10.38	52 59	49.00	95.15	7.80	4.17	130.8
		105	Hot-air	8.89	52.44	49.00	94.28	7.66	4.39	129.1
		75	Vacuum	7.67	48.96	51.64	95.19	7.82	4.01	131.9
4.	Tachysurus sona	33	Snn	6.90	48.99	61.25	91.28	7.06	4.46	122.2
		105	Hot-air	5.06	46.48	59.50	92.26	7.14	4.34	123.0
		75	Vacuum	5.02	43.40	58.26	92.49	7.29	4.29	124.8
5.	Stolepherus sp.	33	Sun	6.86	28.47	60.14	93.89	6.58	4.20	116.5
		105	Hot-air	3.80	27.00	64.74	93.18	6.30	4.07	113.2
		75	Vacuum	6.01	24.00	61.25	94.60	6.49	4 16	115.5
6.	Miscellaneous fish	33	Sun	9.07	28.00	48.34	95.92	7.43	4.06	126.4
		105	Hot-air	6.15	24.99	50.39	94.94	7.56	4.18	127.9
		75	Vacuum	5.21	22 64	50.64	94.19	7.60	4.09	128.4
		70	Tunnel.	7.71	29.57	45.98	95.01	7.78	4,34	130.5
		45	Tunnel	11.46	28.33	53.14	94.77	7.38	3.89	125.9
		118	Steamdrying	6.04	24.29	51.46	93.89	7.40	4.03	126.0