SOME METABOLIC AND HORMONAL EFFECTS OF WHEAT BRAN ON HEALTHY AND SUBJECTS WITH DIABETES MELLITUS

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M.D. THESIS

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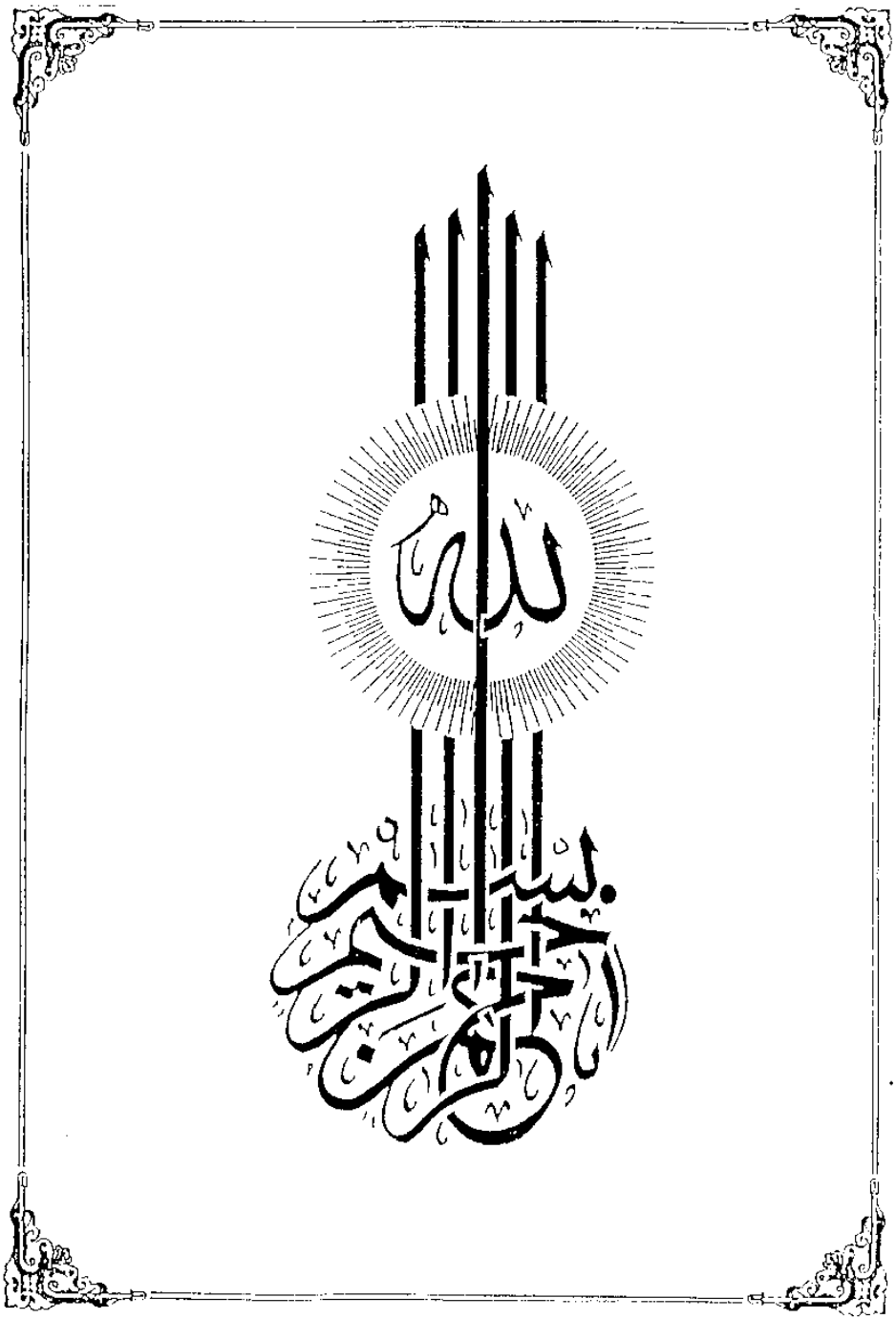

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About ten years ago, the influence of dietary fibre in gastrointestinal motility attracted the attention of medical profession, having smouldered at the back of some minds for decades. Epidemiological and experimental observations led to the suggestion that low dietary fibre intakes, of Western industrialised communities, were responsible for several important diseases. Since then, this idea has stimulated much further work on fibre as well as heated discussions (DINIZIS, F.R., et al, 1977).

In 1875, fat and sugar contributed 15 - 20 % of calories and this has risen to 55 - 60 % (DE WIJN and J.F., NETH, 1970). Table I shows the greatest change in the British diet that has occured in the past hundred years (ANTAR, M.A., et al, 1964).

What is Fibre ?

In the international dialogue on dietary fibre derived from plant sources, there is agreement that dietary fibre components are mainly plant cell wall material and include cellulose, hemicellulose, lignin and pectin. TROWELL (1975) has suggested that the term dietary fibre should apply to all the constituents derived from plant cell walls in the diet which are not digested by human digestive secretions. SOUTHGATE, D.T.A., (1976) has stated that TROWELL's definition "is not wholly acceptable", and in a discussion on the chemistry of dietary fibre, briefly refers to its minor constituents, cell wall proteins found to influence the properties of the dietary fibre in a food . Elsewhere, indigestible portion was either omitted from a list of dietary fibre components, being incorporated as a minor constituent in "associated plant cell wall factors" (SPILLER, G.A., et al, 1976), or its inclusion was termed "not justifiable" ... because "quantitatively in the diet as a whole (it does) not materially affect values for total dietary fibre" (SOUTHGATE, D.T.A., et al, 1978).

Table I : Approximately Daily Consumption of Fibre in the U.K.

	1880		1970		Changes in Fibre intake
	Food	Fibre	Food	Fibre	
Starches :					
Cereals	480	3.2*	120	0.3	- 90 %
Potatoes	300	1.1	120	0.5	- 45 %
Legumes	60	1.0	60	1.0	None
Starchy fibre	...	5.3	...	1.8	- 66 %
Fruit and vegetables	275	2.8	325	3.3	+ 20 %
Total fibre	...	8.1	...	5.1	- 37 %

* Assumed fibre content of bread 0.7 g. per 100 g.

It has been shown, unequivocably, that protein from plant sources is incompletely digested and, in some cases, the indigestible fraction represents a considerable percentage of the total protein. Whether this indigestible protein is of structural cell wall nature, or merely refractory to digestion, is unclear and requires clarification. There is, however, ample evidence that it is not wholly of a cell wall nature in all cases. Indigestible protein should be considered part of the dietary fibre composit. The charged groups in this protein would be expected to be involved in binding, etc., and thus play a role in physiological effects.

As a supporting evidence for this hypothesis the case of wheat bran is cited. Its protein is not totally digested (typically 60 - 85 %) as reported by workers using chicks (SAUNDERS, R.M., et al, 1979), rats, pigs and calves (SAUNDERS, R.M., et al, 1974) and humans (DINIZIS, F.R., et al, 1979). It can be calculated that bran dietary fibre contains about 10 % crude protein. For comparative purposes, the lignin content of bran dietary fibre has been estimated to be 7 % (SOUTHGATE, D.T.A., 1976).

In view of the potential active chemical nature of protein, in contrast to the relatively inert cellulose and hemicellulose, indigestible protein could play a significant role in the observed physiological effects of dietary fibre in the lower digestive tract (SOUTHGATE, D.T.A., 1976).

The amounts of fibre, digestible matter, and "indigestible matter" for bread made from flours of varying extraction rates are shown in Table II : the content of bran increases as the extraction rate rise. The Table shows that the amount of indigestible material at each extraction rate is from about 6 - 20 times the corresponding fibre content (EASTWOOD, M.A., et al, 1974). Commercial wheat bran varies greatly in its content of attached endosperm probably in the quantitative composition of its indigestible constituents and thus in its therapeutic effects. Hence, clinicians wishing to use bran in the treatment of their patients should know its endosperm content, particle size, swelling power and ion exchange capacities (EASTWOOD, M.A., et al, 1974).

Table II : Digestibility of Bread made from Flours of Varying Extraction - Rates and Fibre Contents.

	Extraction - Rate (%) *				
	75	85	90	95	100
% Crude fibre	0.15	0.3	0.8	1.4	2.0
% Digestibility **	97.0	93.9	91.5	88.7	86.3 (88-89)
% Indigestible matter	3.0	6.1	8.5	11.3	13.7 (12-11)

* Percentage of the wheat grain obtained as flour after milling.

** Human studies.

Caution must, therefore, be exercised in comparing the fibre intakes of different communities consuming dissimilar plant diets. Bran is the fibre rich fraction of wheat, containing the protective outer coats of the seeds, which is discarded during the milling of white and other low-extraction flours. Its laxative properties have been known and exploited for many years; and diarrhea has conventionally been considered as a contraindication to the use of bran (KIRWAN, W.O., et al, 1974).

It was claimed that the adoption of roller milling for the manufacture of white flour in 1880s was accompanied by a dramatic change from a high fibre flour, not greatly different from wholemeal, to a high refined white flour almost devoid of fibre.

In Britain, even in the late 18th Century, the meal was frequently sifted into grades of diminishing whiteness, with emphasis on the maximum production of the finest (whitest) grade. Such flour would have had a fibre content below 0.5 %.

To secure an extra intake of 2 g. bran fibre a day requires the consumption of food containing about 19 g. of good commercial bran per day, or about 100 g. of wholemeal flour, corresponding to about 145 g. wholemeal bread. But, in London area at least, the average intake of the bread of 1880 would have yielded only 1.2 g. fibre per day (EASTWOOD, M.A., et al, 1974).

Analysis of dietary Fibre

SCHWEIZER, et al, (1979), described an analytical procedure for the determination of dietary fibre in food. The method consists of an enzyme, in vitro, digestion with pepsin, pancreatin and glucoamylase. Insoluble fibres were recovered by centrifuging (SCHWEIZER, et al, 1979 and ROBERTSON, et al, 1980), and soluble fibres were recovered by precipitation with ethanol which accounted for 4 - 60 % of the total dietary fibre. The component sugars and uronic acids of several fibre fractions were quantitatively determined. The mild biochemical treatment of the samples made it possible to study further physical properties of dietary fibres important for their physiological actions (HEREDIA, M.A., 1980).

Chemical analysis of the insoluble nondigestible fraction from soyabean hulls indicated a composition of 71 % cellulose, 20 % hemicellulose, 9 % lignin plus ash. The percent protein digestibility was estimated as : whole soyabean 68 %, corn bran 43 % and wheat bran 60 % (HONIG, D.H., and