Factors affecting the demand for high protein hard red spring wheat
by Allen B Richards

A THESIS Submitted to the Graduate Faculty in partial fulfillment of the requirements for the degree of Master of Science in Agricultural Economics HhaTrvriflrT. 'Rrrflrrir irincr Hnmmr +,+.PPx^ Chairman, Examining Committee Approved? Bozeman, Montana January, 19#
Montana State University

Abstract:
The following thesis is an attempt to gain a better perspective of the marketing problems facing the producer of high protein hard spring wheat by examining various factors which influence the demand for his product.

Part I introduces the problem and outlines the general methodological procedure used. It outlines the formulated hypotheses which were used as guideposts for the analysis..

A preliminary background for the analysis of the problem is contained in Part II. A brief history of flour milling is given. The various segments of the distribution system are outlined. The last two sections of this part describe the wheat used by the spring wheat millers and the types and properties of the various flours.

Part III contains the analysis of the problem and is broken into seven sections. Section A presents the theory of demand which becomes a framework from which to analyze the data. Section B discusses the role of the flour orders received by the miller in determining and affecting the demand for high protein spring wheat. Section C describes the effect of other wheat and flour markets on demand. Section D analyzes the variations in wheat shipments on the Great Lakes and their relationship to demand and price. Section E considers the fluctuating supplies of various proteins and their effect on the demand for high protein spring wheat. Section F covers the substitution of high protein spring wheat for durum wheat in the manufacture of macaroni products. Section G discusses changing technology in the baking and milling industries and its effect on the demand for high protein spring wheat.

The conclusions and implications of the study are contained in Part IV.

FACTORS AFFECTING THE DEMAND FOR HIGH PROTEIN HARD RED SPRING WHEAT

by

Allen B. Richards

A THESIS

Submitted to the Graduate Faculty

in

partial fulfillment of the requirements

for the degree of

Master of Science in Agricultural Economics

at

Montana State College

Approved:

Roy E. Huffman
Head, Major Department

Edward N. Ward
Chairman, Examining Committee

J. A. Nelson
Dean, Graduate Division

Bozeman, Montana
January, 1955

CONTENTS

LIST OF TABLES

LIST OF FIGURES

ACKNOWLEDGEMENTS

The writer wishes to express his sincere appreciation for the help and guidance given by several persons and organizations in the preparation of this thesis.

The Minneapolis and Duluth Boards of Trade responded generously to several requests for information. Members of the grain trade were kind and helpful in presenting the writer with data used in this study. Members of the staff in the Department of Agricultural Economics and Rural Sociology have been helpful in their suggestions and criticisms of this work. Professor Layton S. Thompson devoted considerable time to the review of the manuscript as it was prepared.

The writer is especially indebted to Professors Edward H. Ward and Clive R. Harston for their encouragement, guidance, and critical review of the writer's work. However, the writer assumes full responsibility for the ideas and conclusions contained in this thesis.

ABSTRACT

The following thesis is an attempt to gain a better perspective of the marketing problems facing the producer of high protein hard spring wheat by examining various factors which influence the demand for his product.

Part I introduces the problem and outlines the general methodological procedure used. It outlines the formulated hypotheses which were used as guideposts for the analysis.

A preliminary background for the analysis of the problem is contained in Part II. A brief history of flour milling is given. The various segments of the distribution system are outlined. The last two sections of this part describe the wheat used by the spring wheat millers and the types and properties of the various flours.

Part III contains the analysis of the problem and is broken into seven sections. Section A presents the theory of demand which becomes a framework from which to analyze the data. Section B discusses the role of the flour orders received by the miller in determining and affecting the demand for high protein spring wheat. Section C describes the effect of other wheat and flour markets on demand. Section D analyzes the variations in wheat shipments on the Great Lakes and their relationship to demand and price. Section E considers the fluctuating supplies of various proteins and their effect on the demand for high protein spring wheat. Section F covers the substitution of high protein spring wheat for durum wheat in the manufacture of macaroni products. Section G discusses changing technology in the baking and milling industries and its effect on the demand for high protein spring wheat.

The conclusions and implications of the study are contained in Part IV.

Part I

INTRODUCTION

A. The Problem

I. Introduction and Problem Situation

For thousands of years bread has been the staple diet of Western man and one of the world's most indispensable products. Even in recent years when our higher standards of living and increasing variety in foods have resulted in less reliance upon bread, it has, nevertheless, remained one of our basic foods.

Good bread, unfortunately, cannot be made out of every type of wheat produced. It must be wheat that contains the proper quality and quantity of protein. It has been only in the last three decades, however, that protein has been given recognition in the grain markets. In 1925, the first premiums for protein were established on the Minneapolis market. Since then, protein premiums have grown to occupy an important position in our agricultural economy. It has been estimated that in the state of Montana alone, if protein premiums were considered a separate commodity, they would represent the fifth largest crop, exceeded only by wheat, cattle, sheep, and dairy. 1/ Protein premiums are paid on "high protein" wheat which is generally considered to be wheat containing more than 12 per cent protein.

1/ H. R. Stucky and M. C. Taylor, Looking Ahead With Montana Farmers and Ranchers, Folder 22, Montana Extension Service, Montana State College, Bozeman, Montana, September 1, 1952.

The premiums are expressed as increasing premiums for every one-tenth or one-half per cent protein over 12 per cent.

The payment of protein premiums, even though it has helped the producer to increase his income, has caused additional uncertainty to the dealer and producer engaged in an already uncertain field. Wheat prices fluctuate daily but the effects of this fluctuation can be greatly minimized through hedging in the futures market. Protein premiums, however, cannot be hedged and thus cause additional anxiety on the part of those holding high protein wheat for which premiums have been paid.

The producer has questioned at times whether or not all of the premiums paid by the miller are being reflected back to himself. The payment of premiums have tended to establish protein as a separate commodity. The producer knows in a general way how his grain moves to market, yet there may be some question as to whether or not high protein wheat follows the same marketing pattern as that of ordinary wheat. Premiums, in themselves, represent an important part of the producer's income and for this reason it is to his advantage to know about them and how they are established.

On the production side, the producer has received help from industry, government, and educational institutions. Countless hours have been spent developing new varieties of wheat for the producer. Other measures have been taken to give the producer the best possible advantage in raising his crop. However, what happens to his grain after it is harvested is just as important to the producer. Unless he can sell his grain at a fair price, he is not benefiting fully from his production efforts. The producer, therefore, is interested in what happens to his high protein wheat when

it leaves his farm in the Northern Great Plains. He is interested in those who handle the wheat and aid its movement to market. He is interested in those who buy and sell the wheat after it has arrived on the market. In addition, he may want to know how the wheat is used, the products made from it, and the uses for these products. In general, the producer is interested in the movement of wheat from his farm to the ultimate consumer who uses wheat in its final form of bread and other baking products.

II. Statement of the Problem

This study is concerned with the factors behind the demand for high protein hard red spring wheat, the reasons for the fluctuations in demand, and the effect the demand factors have on price.

Prices are determined by various supply and demand factors. An examination of both must be made in order to analyze prices completely. However, this study is concerned only with the demand factors and their effect on the price the producer receives for his high protein spring wheat.

III. The Objective of this Study

The objective of this study is to isolate, examine, analyze, and describe the factors which affect the demand for high protein hard red spring wheat and their relationship to price.

A knowledge of the factors behind the market price for high protein spring wheat would be helpful to the producer and give him a better understanding of the complexity of market operations and explain why he receives a particular price for his wheat. Not only will the producer

benefit, but the rest of the grain trade and others affected by the price of high protein spring wheat will come to a greater appreciation for each other's problems.

The demand for high protein spring wheat is a derived demand from the consumers' demand for bread and other baking products. Since the objective is to analyze the demand factors, this study concerns mainly the milling and baking industries because they are the consumers and processors of wheat and wheat products. Therefore, further discussion will be located primarily in these areas.

B. Statement of Hypotheses

The demand for high protein hard red spring wheat is affected by the following major factors: (1) Flour orders received by the millers; (2) Other wheat and flour markets; (3) The seasonality of shipping on the Great Lakes; (4) The blending of protein; (5) The durum wheat crop, and; (6) Changing technology in the milling and baking industries.

(1) Flour orders received by the millers represent the major factor behind the demand for high protein spring wheat. The millers' demand for wheat is dependent on their sales of flour. The millers buy wheat to meet the flour commitments.

(2) Buyers from other market areas enter the spring wheat market for wheat and cause a shift in the demand curve as well as more elasticity. The reverse situation brings about substitutes for spring wheat and causes the demand for spring wheat to be more elastic.

(3) The seasonality of shipping on the Great Lakes causes a seasonal change in the demand for spring wheat. During the latter part of the open season there is a decrease in the elasticity of demand. The seasonality also shifts the demand curve--the amount and direction depending on the season.

(4) The necessity of blending proteins causes fluctuations in the demand for the individual proteins depending largely on the relative supplies.

(5) The shortage of durum wheat causes an alternative use for high protein spring wheat. This makes the demand for spring wheat more elastic.

(6) Changing technology in the milling and baking industries cause the demand to be more elastic by providing substitutes for high protein wheat.

C. Methodological Procedure

I. Data Used and Method of Analysis

The primary data used in this study were empirical evidence gathered by direct interview with members of the flour milling industry and by mail from members of the baking industry. The data received from the milling industry were by far the most exhaustive and representative.

Fifteen flour millers in Montana, North Dakota, and Minnesota were interviewed. These millers produce approximately one-third of all the flour produced in the United States, and approximately 65 per cent of the flour produced in the states of Montana, North Dakota, and Minnesota. They were selected because they are the largest millers in the Northern Great

Plains and their practices probably have more influence on the market than all the smaller mills. Most of the millers are national in size, and their policies and practices are indicative of the flour milling industry as a whole.

Members of the baking industry were contacted by mail. A mail questionnaire was sent to each of 28 bakers throughout the country. Nine completed questionnaires were returned. These nine are sufficiently scattered around the country so that a general picture of bakers' practices in several areas has been obtained.

The secondary data used came mostly from the grain trade and trade periodicals. Information gathered from the Northwestern Miller was extremely helpful. The Duluth and Minneapolis Boards of Trade provided excellent sources of information, particularly through the use of their Annual Reports.

The millers' schedules were first assembled and composite results obtained to all questions. Similar procedure was used in dealing with the bakers' questionnaires. These composite results were then analyzed and used to test the hypotheses, together with results of a statistical analysis of both primary and secondary data. After testing the hypotheses, inferences were drawn and some general conclusions were reached.

II. Procedure Used in this Study

The initial phases of this study were spent in reviewing literature in the field of wheat marketing in order to gain a better perspective of the problem. The amount of literature available, however, was found to be

rather small. Therefore, this study relies very greatly on empirical information.

From the over-all problem of high protein wheat marketing, the specific problem was selected. By limiting the study to the specific problem a detailed analysis can be made. At the same time, however, the specific problem is still broad enough so that it fits into the larger problem of high protein wheat marketing. The importance of the size of the specific problem to be attacked lies in the fact that another smaller problem could have been selected and examined from every conceivable aspect and in a much more thorough manner. Yet, a solution to such a small problem would be so small a part of the larger problem of high protein wheat marketing that it would contribute little to solving the larger problem. It is felt, therefore, that any solution of the problem with which this study is concerned will be meaningful and contribute something to the solving of the larger problem of high protein wheat marketing.

The next step was the formulation of hypotheses. A set of hypotheses was arrived at through deduction from the specific problem and through induction from the literature reviewed. These hypotheses were then used as guideposts in proceeding from the known into the unknown; i.e., proceeding into the actual analysis of the problem. Larrabee says hypotheses "go beyond the given to a possible patterning or arrangement or interpretation of it; and they do so provisionally, with a definite view to ultimate confirmation or rejection after testing". 2/

2/ Harold A. Larrabee, Reliable Knowledge, Houghton Mifflin Company, Cambridge, 1945, p. 168.

In order to examine the problem and test the hypotheses, empirical data were collected and secondary information gathered. This information was used to test the hypotheses, and to make some necessary adjustments in both the problem statement and the hypotheses.

Part III of this report covers the analysis of this data and the testing of the hypotheses. Part IV presents the conclusions and inferences drawn from the analysis. However, before proceeding into the analysis it will be helpful to have a picture of several phases of wheat marketing and their relation to this study, and a picture of the commodity, flour, with which this study is concerned. Therefore, Part II covers the necessary material to provide an adequate background for interpreting the specific points to be covered in Part III, the analysis of the data.

Part II

BACKGROUND TO THE ANALYSIS

A. The Market Structure

I. Introduction and History

There probably is no other industry which has a longer history in the United States than the flour milling industry. The first American manufacturing establishments were devoted to grain grinding. The history and growth of flour milling parallels the history and growth of our country.

The first known flour mill was founded on the Eastern seaboard in 1632. In subsequent years, flour milling grew up along the eastern coast and New York City established itself as the flour center of this period. As the nation expanded, wheat growing and flour milling spread throughout all the colonies. Poor milling facilities, and the high cost of transportation tended to make each area self-sufficient, and therefore, most of the mills were small custom mills, serving only local trade.

Westward expansion of the nation brought about a similar expansion in the milling industry. The wheat growing areas shifted to western New York and the Midwest with Philadelphia, Baltimore, and Rochester becoming the leading flour markets and milling centers. Further westward movement brought the wheat farmer out onto the great plains. Again the centers of milling and the flour markets moved with the crop. Cincinnati, St. Louis and New Orleans took their place in milling history as the centers for this period. Finally, the home market demand, the lack of transportation to the east, and the undeveloped state of transportation in the west tended to

bring about mill development in the western plains. 1/

Milling began at what is now Minneapolis as early as 1822-23 with the establishment of a small gristmill to serve the soldiers at Fort Snelling. Settlers moved very slowly into the area and for a number of years were outnumbered by trappers, lumbermen, and miners.

After 1851, there was a rapid increase of population in Minnesota. Flour and feed mills sprung up all over the state. By 1860 there were 81 mills turning out products worth over $1,200,000. The development of Minneapolis as a milling center was, up to 1870, the result of the movement of farmers and mills into the great plains. After 1870, the rapid rise of Minneapolis was due to a revolution in milling processes which resulted from the introduction of the purifier and roller system. These new processes brought supremacy in world trade to American flours and the Minneapolis millers in the period following 1870.

Commercial milling developed in North Dakota and South Dakota in the 1890's and in Montana after 1900. At the same time there was a concentration of mill ownership in those areas. The Russell-Miller Company was organized in 1897. In 1911 the Montana Flour Mills Company began operations in Harlowton, subsequently building a large mill at Lewistown.

Other large combines came about in this same period. The International Milling Company appeared at New Prague, Minnesota and rose to a present daily capacity of 53,400 sacks. (100# sacks). Commander-Larabee Corporation was founded by bringing together mills scattered about Minnesota and Kansas.

1/ Charles B. Kuhlmann, The Development of the Flour Milling Industry in the United States, Houghton Mifflin Company, New York, 1929.

Commander-Larabee now has a daily capacity of 38,640 sacks. The trend towards concentration has continued up to the present day with the large getting larger and the small dropping by the wayside. 2/

II. Marketing Channels

a. The Marketing Process

The first step in the marketing process is the delivery of wheat by the producer to the country elevator. The country elevator places the wheat in storage or loads it into a boxcar for immediate shipment. The country elevator generally buys the grain from the producer. However, in some cases it is stored in the producer's name. Storage for producers is not very prevalent today partly because the elevators are storing Commodity Credit Corporation wheat instead. The country elevator is a collection point for wheat produced in the surrounding area. Very little of the wheat moves directly from producer to terminal market.

The elevator contacts a commission firm at the terminal market, in this case Minneapolis or Duluth, and notifies it of the quantity and quality of wheat enroute to market or on hand. The commission firm hedges the wheat for the country elevator. When the wheat is received on the market it is tested for protein and quality. The commission firm then places a sample of the grain on the trading tables on the cash floor and proceeds to bargain with prospective customers.

The largest share of the cash wheat is purchased by processors like

---

2/ Charles B. Kuhlmann, Ibid.

the flour miller. The miller grinds the wheat he buys on the cash floor into flour and feed, and sells these products to bakers, feed mills, and others desiring the products. The baker, in turn, makes bread from the flour and sells it to the consumer.

b. The Terminal Elevator

The terminal elevator firm today is primarily a grain merchandiser rather than just the supplier of a large storage warehouse for grain. The terminal elevator firm purchases wheat in its own name and proceeds to clean it and bin it by narrow ranges of protein. The large facilities permit it to store huge quantities of wheat, and other grains, and to be in a position to blend different wheats to satisfy particular customers.

c. The Commodity Broker

The commodity broker differs from the commission firm in that he operates only on the futures market. His job is to buy and sell contracts for future delivery of wheat and other commodities. The broker may be both a securities and a commodity broker, or he may specialize in commodities alone. His customers represent every segment of the marketing structure. Millers, terminal and country elevators, and speculators are among the broker's customers.

d. The Speculator

The speculator, as found in the commodity markets, is a person who buys and sells on the futures market in order to make a profit from the transactions. The speculator holds no commodities nor takes possession of any. Many feel that the speculator does more harm than good. However, without him there would be no futures market. It is the speculator who is

always present ready to buy when the country elevator wishes to hedge, or to sell when the elevator wishes to reverse the hedge. Naturally, it is not always the speculator who purchases the hedge, but without his presence, hedging as it is now practiced would be impossible.

III. Production Areas

There are four major wheat producing areas in the United States, each distinguished by the type of wheat that is predominant in the area: (1) The hard spring wheat area comprising North Dakota, South Dakota, Montana, and Minnesota; (2) The hard red winter wheat area of Texas, Oklahoma, Kansas, and Nebraska; (3) The soft red winter wheat area of Eastern Kansas, Central Texas, Missouri, Lower Illinois, Indiana, Ohio, and the Central Atlantic Coast states; and (4) The soft white wheat area of California, Oregon, Idaho, and Washington. These production areas each supply a particular milling center or market with a large part of its wheat. 3/

Stigler defines a market area to be "the area within which the price tends to uniformity, allowance being made for transportation costs". 4/ The Minneapolis price for wheat tends to be the price throughout the spring wheat production area with allowances for freight. Therefore, Minneapolis is the spring wheat market center. This study concerns itself with the hard spring wheat area and its particular milling centers which are Minneapolis and Buffalo. Duluth is the transit point for wheat moving to

---

3/ Commodity Research Bureau, Commodity Yearbook, New York, 1952, p. 340.

4/ George J. Stigler, The Theory of Price, The Macmillan Company, New York, 1946, p. 92.

Buffalo, the largest spring wheat milling center. Minneapolis, however, is the world's largest cash wheat market.

IV. Size of Spring Wheat Milling Centers

As has been stated previously, Minneapolis and Buffalo are the two primary spring wheat milling centers. Minneapolis and Duluth are the spring wheat markets where prices are quoted daily on cash receipts of spring wheat.

Buffalo flour production amounted to 26,216,130 sacks in 1953. Minneapolis produced 13,578,063 sacks in the same year. By comparison, Kansas City produced 13,017,915 sacks in 1953 out of a total U. S. production of 221,852,000 sacks. This means that Buffalo produced approximately 12 per cent of the total U. S. flour in 1953, while Minneapolis and Kansas City each produced about 6 per cent.

Buffalo ranks No. 1 in total daily capacity with 94,700 sacks. Minneapolis is second with 68,800 sacks; Kansas City third with 54,420 sacks; Dallas-Ft. Worth fourth with 26,700 sacks; and Salina fifth with 15,000 sacks. 5/

V. Purchases and Practices of the Millers

a. Location and Method of Purchasing

Minneapolis millers obtain more than 75 per cent of their wheat from Montana and North Dakota. In 1952 and 1953, Montana was the largest supplier. Other Northern Great Plains millers purchase most of their wheat

---

5/ The Miller Publishing Company, Northwestern Miller Almanack, Minneapolis, 1954, p. 24.

from these two states also. Table I shows the source of wheat purchased by 15 flour millers in the Northern Great Plains. Seven of these millers purchased 100 per cent of their wheat from Montana and North Dakota. The others purchased at least 75 per cent of their wheat in these states.

Table I.

Source of Wheat Milled by Northern Great Plains Millers
1952 Crop Year

	Company														
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
	Per Cent of Total Purchases														
Mont.	35	50	40	25	75	25	50	60	40	100	100	100	100	100	25
N. Dak.	50	40	60	55		50	30	25	45						75
Pac. N.W.															
Kan., Okla.								10	5						
Minn., S. Dak.	15	10		20	25	25	20	5							

The millers generally purchase their wheat through commission firms on the cash market rather than buy direct from country elevators or producers. This way the miller can actually see the wheat he is buying and is dealing with a specialized agency. The commission firms generally represent the country elevators on the cash floor, although they may sell wheat for producers or terminal elevators. Twelve of the 15 millers interviewed purchased 90 per cent or more of their wheat through commission firms. Only two mills purchased more than one-fourth of their wheat direct from country elevators or producers.

The millers apparently try to purchase their wheat from the same areas and localities every year. Of course, this fluctuates because of changes in protein and wheat quality which is due primarily to the unpredictable weather found in these areas. Over the years the millers have established certain localities that produce the desired quality of wheat. The millers tend to favor these areas in their purchasing and try to buy from them before going elsewhere for their wheat. Country elevators, too, have established reputations with the millers, some good and some bad. These reputations are very important to the millers. The millers keep a close check on the wheat coming from the elevators and know which ones are delivering superior wheat. The millers regrettably find that some elevators attempt to ship plugged cars and wheat with excessive dockage. These elevators are soon known throughout the trade, and the trade prefers not to handle their wheat. The millers have stated that for awhile an elevator may get away with car plugging, but eventually the practice is discovered and further shipments from such an elevator are not accepted very readily, sometimes only at a discount. In the long run these practices may harm not only the elevators but also the farmers these elevators serve.

Most of the millers purchase all the wheat they can store during the harvest season. Buffalo millers try to get as much wheat as possible over the Great Lakes before they close. Thus their purchasing is done during the harvest season and in the post-harvest season as well.

The millers all do some contracting for future deliveries but these are usually short term contracts. Most of the contracting is done in the

late summer or early fall. The time and amount of contracting will depend upon the supplies available and the expected price movement.

b. Protein Content of Purchases

"Millers and bakers are not interested in the protein content of wheat and flour from a dietary viewpoint. Premiums are paid for high protein wheat because protein content is a crude measure of gluten quality." 6/ Protein content may be used as a measure of quality because it is simple and is a general indication of the gluten contained in the wheat. About 85 per cent of the dry gluten is protein, so the greater the protein content, the greater the gluten content.

The wheat purchased by the Northern Great Plains millers is generally that classified as high protein wheat. This is indicated by a 155 week period from 1951 to 1954 in which 76 per cent of the total car lots sold at Minneapolis tested more than 12.5 per cent protein. 7/

The mills generally buy to meet their own particular milling requirements. Most of the millers indicated that they like to buy the middle range of protein (13-15 per cent) before acquiring any other proteins. They tend to set their purchasing policy on high protein wheat according to the harvest every year. If there appears to be a large supply of high protein wheat they will hold off their purchases until they need the wheat for

---

6/ E. R. Hehn, Protein of Wheat as a Measure of the Milling Characteristics of the Flour, Memo to members of Committee on Objectives of Research and Extension Education with reference to protein in Montana's hard wheats, October 12, 1951.

7/ Recorded from Daily Market Record, Minneapolis, April 23, 1951 to May 10, 1954.

milling. On the other hand, if the supply of high protein wheat appears to be short, they will try to stock up on it for future needs. Some mills try to get their high protein early while others buy as they need it according to available supplies.

A survey of the protein content of spring wheat purchased by 11 Northern Great Plains millers shows that only one company out of eleven purchased more than 8 per cent of its spring wheat below 12 per cent protein. The protein content of the wheat purchased by the various mills is indicated by Table II. Most of the companies purchased between 70 and 85 per cent of their spring wheat in the 13-15 per cent bracket.

Table II.

The Protein Content of Spring Wheat Purchased in 1952 by 11 Northern Great Plains Flour Millers

	Company										
	1	2	3	4	5	6	7	8	9	10	11
	Per Cent of Total Purchases										
11% and Below	5	8	5	-	5	5	5	-	30	-	-
12%	50	0		80	60	0	45	95		30	10
13%		80	70			75			60		85
14%	30			5 to 10	15		20	4		60	
15%						-					
16% and over	15	12	25	10	30	20	30	1	10	10	5

The winter wheat purchased by Northern Great Plains millers is lower in protein than the spring wheat purchased. Of the 8 mills that reported

purchasing winter wheat, most of them bought winter wheat under 14 per cent protein. A large part of their purchases was in the 11 per cent and below category, although the majority of the purchases fell in the 12-13 per cent range. Table III gives a picture of the winter wheat purchases.

Table III.

The Protein Content of Winter Wheat Purchased in 1952 by 9 Northern Great Plains Flour Millers

	Company								
	1	2	3	4	5	6	7	8	9
	Per Cent of Total Purchases								
11% and Below	50	Bulk			100		50	10	5
12%	50	Some		Bulk		100		70	90
13%							50		
14%	--	--						15	5
15%	--	--	100	Little				5	
16% and over	--	--							

All this would indicate that "wheat on the Minneapolis market" can be considered to be high protein wheat. Thus, this study concerns itself with "wheat on the Minneapolis market", and also wheat on the Duluth market. The data used in this study have been analyzed and discussed on the basis that Minneapolis and Duluth wheats are high protein wheats, and that the

base prices quoted on these markets are base prices for high protein wheat. Naturally, additional premiums are given for additional protein, but this study concerns itself mainly with demand factors and their relation to the base price of high protein hard red spring wheat.

B. Flour

I. Flour Types and Uses

The flour produced in the Northern Great Plains may be divided into three major groups: Bakery, family, and specialty flour. Bakery flour is flour sold to bakers for processing into bread. Family flour is flour sold at the retail level to the consumer for use in his home. Specialty flour is sold to bakers to make special products like french bread, whole wheat bread, kaiser rolls, and hard rolls. Bakery flour represents the largest proportion of the millers' total sales.

Twelve Northern Great Plains millers reported on the per cent of total output represented by the various types of flour. Bakery flour represents 40-50 per cent of the total output for 5 of the 12 millers. It represents 70 per cent or more of the total output for the remaining seven millers. Table IV gives a complete picture of the flour produced by these 12 millers.

Flours in general have names applied to them which indicate their quality and reflect the quality of the wheat from which they were milled. Names vary with the miller and are difficult to compare unless a comparison is made of flours produced by one miller. Flours can be grouped either as "patents" or "clears", but both groups overlap and will vary from one milling location to another. The term "patent" originated through the

Table IV.

Type of Flour Produced by 12 Flour Millers in the Northern Great Plains - 1953

	Company											
	1	2	3	4	5	6	7	8	9	10	11	12
	Per Cent of Total Output											
Bakery	44	95	70	95	85	80	40	50	48	90	75	40
Family	44	5	15	5	15	20	60	50	52	10	25	20
Specialty	12											40
Export			15									

invention of the middlings purifier. Prior to this time (1870) some of the high quality flour stock was left in the middlings. It was to the millers' advantage to be able to recapture this quality stock. This was accomplished through the invention of the middlings purifier. The purifier was patented and when added to the miller's machinery caused the miller to call his flour "patent" flour. Today the term has lost its original meaning because all the mills now use middlings purifiers. 8/

Flours of the same name will vary from one locality to the next. The miller must take the wheat that is available to him and grind it into flour. Since wheat differs in size, shape, quality, and protein, the flours produced will also vary. One miller's patent flour may not be as high in quality as another's first clear, therefore, the terms are only relative indications of the kind and quality of flour. This has caused millers to

---

8/ Harry Snyder, Bread, The Macmillan Company, New York, 1930, p. 144.

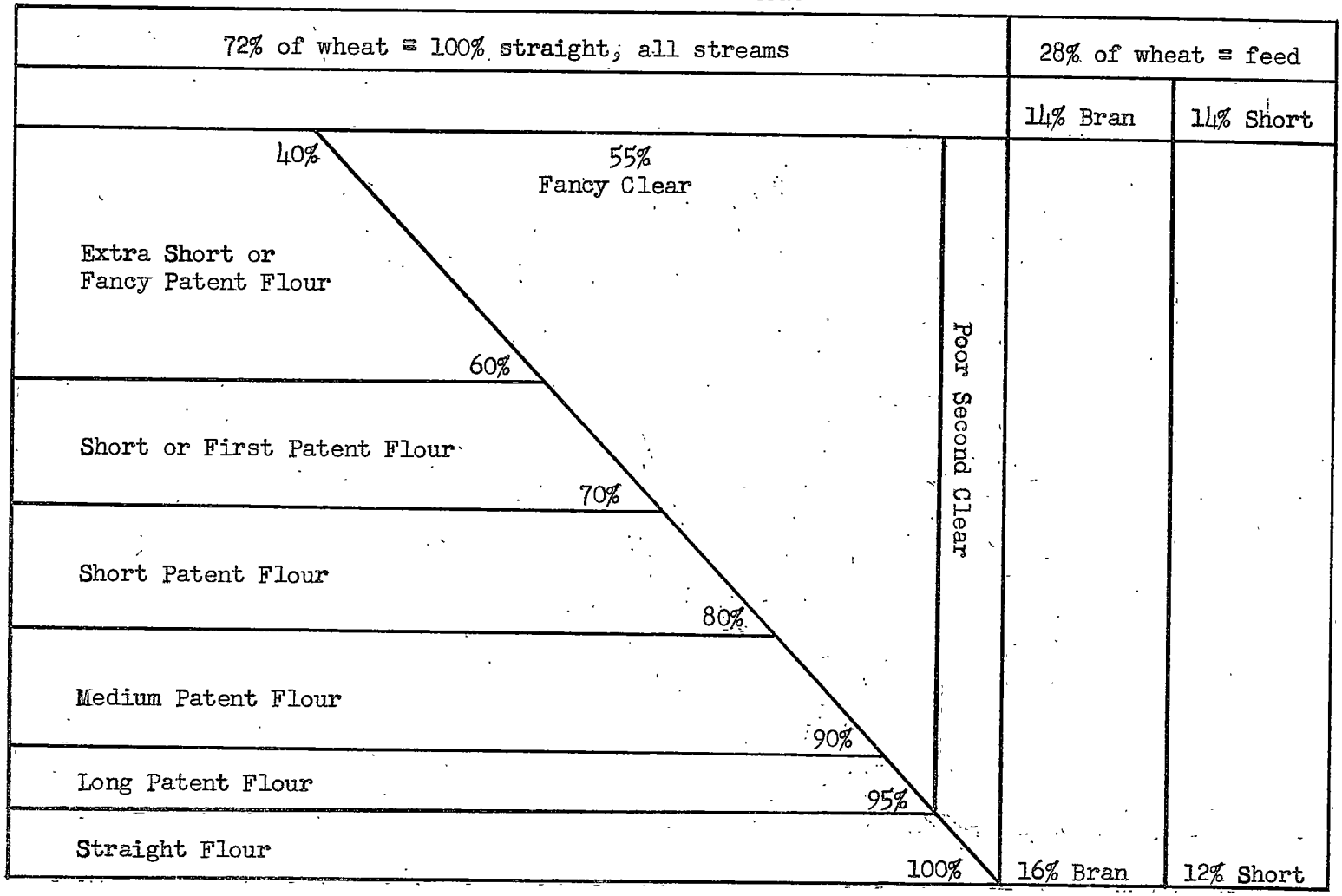
blend wheats from several sources in order to maintain a more uniform product year after year. The millers would like to be able to produce the same quality of flour every year, but this is not always possible since the raw material is never the same twice in a row. Blending thus becomes a method for reducing this variation.

C. O. Swanson modified a chart prepared by the American Institute of Baking to give a picture of the relationship between various grades of flour. 9/ The chart, shown in Figure 1, indicates that the grades merge into each other, making it difficult to identify the grades precisely. A 95 per cent long patent may be very similar or identical with 95 per cent straight flour. An 80 per cent short patent may be the same as an 80 per cent medium patent.

Swanson also found that approximately two-thirds of the protein contained in the wheat goes into the flour. One-third goes into the feed. Table V shows the relative protein per cents of products made from hard red winter wheat. The bran and shorts represent about 27.7 per cent of the wheat ground. Their protein content was 15.1 per cent as against 12.5 per cent for the raw wheat. This indicates that the flour from the center of the kernel or the highest quality flour, has a lower protein content than the whole wheat, and the flour from the outer parts of the endosperm near the bran, a higher protein content than the wheat. This has been found true of hard wheats but not of soft wheats.

9/ C. O. Swanson, Wheat and Flour Quality, Burgess Publishing Company, Minneapolis, 1938.

Figure 1
The Relationship Between Flour Grades
100 Pounds of Wheat*



*Source: C. O. Swanson, Wheat and Flour Quality, Burgess Publishing Company, Minneapolis, 1938, p. 145.

Table V.

Distribution of Protein in Products from Hard Red Winter Wheat*

Portions	Percent of Wheat Obtained in Milling	Protein Percents	Percent of Total Protein
Wheat	100.0	12.5	12.50
Midds. Flour	47.8	10.7	5.11
Break Flour	19.7	13.1	2.58
Tails Flour	3.8	12.5	.48
Bran and Shorts	27.7	15.1	4.33

*C. O. Swanson, Wheat and Flour Quality, Burgess Publishing Company, Minneapolis, 1938, p. 148.

Table VI shows the protein content of various flour streams as compared to the whole wheat. Here the 70 per cent patent had a protein content of 11.2 per cent as against 13.0 per cent for the wheat. The 27 per cent clear contained 13.7 per cent protein. The figure also shows the protein contents of the various breaks in the milling process. The first,

Table VI.

Variations in Protein Content of Mill Stream Flours*

Mill Stream	Protein Content	Mill Stream	Protein Content
Wheat	13.0	1st Sizings	10.8
Patent - 70%	11.2	2nd Sizings	11.4
Clear - 27%	13.7	1st Middlings	11.0
Low Grade - 3%	14.1	2nd Middlings	11.1
1st Break	11.5	3rd Middlings	11.5
2nd Break	12.7	4th Middlings	12.1
3rd Break	13.8	5th Middlings	12.0
4th Break	14.9	6th Middlings	12.3
5th Break	18.1	7th Middlings	12.7

*C. O. Swanson, op. cit., p. 146.

containing patent flour, had a 11.5 per cent protein content, while the fifth which is mostly bran, had a protein content of 18.1 per cent. It can

be said that on the average the flour obtained in the milling process contains about 1.25 per cent protein less than the wheat from which it is milled; i.e., a 13.5 per cent protein wheat would produce a 12.25 per cent protein flour.

II. Production and Consumption of Flour

The production and consumption of flour in the United States has remained relatively constant for the last 20 years. The 1935-39 average flour production in the U. S. was 101,749,000 barrels (196# barrels), and the 1950 production was 116,826,000 barrels. 10/ A similar result is obtained when comparing the production in Minneapolis and Buffalo for the years 1935 through 1953. 11/

A comparison of the consumption of flour in the U. S. shows results similar to those mentioned previously. In 1935, 194,007,000 sacks (100# sacks) of commercially produced flour were consumed. In 1952, 201,656,000 sacks were consumed. 12/ However, while the total consumption has remained nearly the same, the per capita consumption has decreased. In 1935, the per capita consumption of commercially produced flour was 150.4 pounds. In 1952, it was 129.7 pounds. 13/

10/ Commodity Research Bureau, Commodity Yearbook, New York, 1952, p. 354.

11/ For complete data, see Table I in the Appendix.

12/ For complete data, see Table II in the Appendix.

13/ For complete data, see Table III in the Appendix.

III. General Properties of Bread Flour

a. Gluten

The most important factor to be considered in a good bread flour is the gluten. The quality and quantity of the gluten, when considered jointly, have more to do with producing good bread than all other factors combined. 14/ The dry gluten mass contains about 85 per cent protein, 8 per cent of a phosphorized fat-like material that affects the physical binder qualities of the gluten, and approximately 6 per cent starch mixed with small amounts of other substances. The proteins in gluten are gliadin and glutenin, two of the main proteins in wheat. These proteins form the binder that makes bread dough.

Gliadin is the cement or binding material in the gluten, and glutenin is the necessary bulk or substance to which the gliadin particles adhere. When these two are combined in the right proportions, a well-balanced gluten is obtained. If there is too much gliadin, then the gluten becomes too soft and sticky. However, if there is too much glutenin, the dough cannot expand properly because there is not enough gliadin to hold the particles together and retain the gas which expands the dough. In good hard wheats approximately 60 per cent of the gluten is gliadin and 40 per cent is glutenin. 15/

When the right quantity and quality of gluten is present in a flour then the resulting dough will be elastic and possess good recoiling

---

14/ Harry Snyder, Bread, The Macmillan Company, 1930, p. 235.

15/ Ibid.

properties. It is the gluten which determines the loaf volume and mixing tolerance. Generally, the stronger the gluten is, the longer the mixing time and the greater the tolerance.

b. Protein and Ash

Besides the two gluten proteins, there are four other and minor proteins in wheat flour that are not a part of the gluten, but form a part of the protein. It is the proteins in the flour that combine physically and possibly chemically with water to form bread dough. 16/

"Ash is the non-combustible matter remaining after flour has been incinerated in a furnace at a high temperature, and is an indication of the flour extraction and grade." 17/ Generally speaking, the lower the ash content, the higher is the quality of the flour. However, like other properties of flour, the ash content in itself does not always indicate quality flour. It must be taken into consideration along with other factors.

c. Other Properties

Besides the gluten, protein, and ash there are other general characteristics that indicate good bread flour. These characteristics are either connected with the gluten and protein in some way or else are subjective qualities that can only be determined after the bread is baked.

16/ Ibid.

17/ Letter from Mr. T. R. Aitken, Chemist, Board of Grain Commissioners for Canada, Grain Research Laboratory, Winnipeg, Canada, March 2, 1953.