flours derived from other cereals including sorghum, millet, maize and even cassava starch, supplemented with legume proteins. The Chorleywood process uses high energy mixing to replace natural fermentation in dough development. It occurred to the staff of IDRC that mechanized dough development might be achieved by employing sheeting rollers as are used in many bakeries in the Caribbean and in parts of Africa.

The idea was discussed with Dr. Walter Bushuk, Professor of Plant Science at the University of Manitoba, who had been exploring bread-making using composite flours. Dr. Bushuk, an outstanding cereal scientist, undertook to direct and elaborate upon a hand-operated mechanical development process using sheeting rollers.

"The idea is to use zero power to make bread from flour with locally available materials and as little wheat as possible," explains Dr. Bushuk.

Bicycle built for bread

This "practical mixing" method uses a hand-operated or bicycle-operated paddle mixer on flour made from wheat plus one other grain or legume (or possibly two others or even more). This is followed by developing the dough between special but simple "sheeters", and the baking of loaves.

In a demonstration, Linda McConnell, the single technician in the IDRC project, first churned for five minutes at 100 revolutions a minute a mixture of 60 per cent of a small amount of blended flour plus shortening, yeast, salt, sugar, water, malt, bromate and ascorbic acid. She added the balance of the flour and kneaded the resulting dough by hand. The dough was scaled off to 160 grams and left in a bowl covered with a damp cloth for a half-hour.

Then Mrs. McConnell passed the dough between two metal sheeting rollers run by an electric motor. "Stronger" dough is subject to 40 sheetings, "weaker" dough to 20 to 30. The sheets were fermented for ten minutes at 80 percent relative humidity and 96 degrees Fahrenheit, passed through the sheeter three times more, rolled up and placed in a molder for 30 seconds.

The dough was put in "pup-loaf" tins, which went into the fermentation cabinet for proofing and then into a revolving oven with a capacity of five loaves, Mrs. McConnell baked them at 430 degrees Fahrenheit for 25 minutes.

Availability of materials

All the ingredients are available in developing countries in one form or another except possibly bromate and ascorbic acid, which improve the dough but are unnecessary.

The sheeting rolls can be made of hard wood and turned by hand – or bicycle. An ordinary two-wheeler like those used by millions of people in developing countries is installed in the laboratory, and the rear wheel or possibly the sprocket can be used to turn the rolls. A bicycle can also be used to turn a churn or paddle for mixing flour.

Passing dough through a roller run by a bicycle, a vehicle common in developing countries.

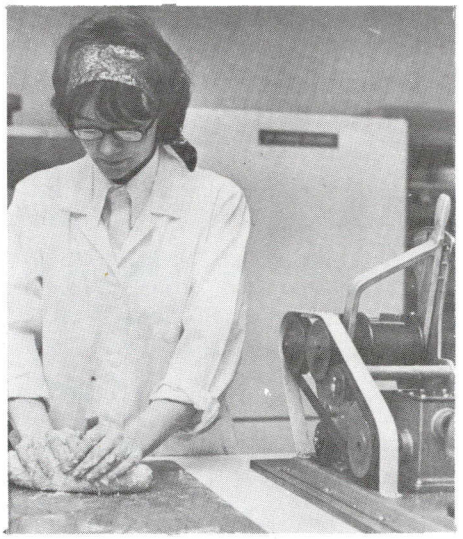
Fermentation can be done naturally instead of in a cabinet, and a brick oven using wood as fuel can be used instead of an electric oven. Remixing is sometimes done in the laboratory after fermentation but hand methods are better in the sense that the dough structure is less likely to break down.

The experimental pup-loaves vary in quality depending on what is mixed with wheat and in what proportion. Dr. Bushuk said a mixture of 20 percent African millet and Canadian wheat produces a loaf up to Canadian standards. A loaf of 20 percent corn and wheat is also considered good, and a loaf of 20 percent sorghum and wheat almost as good. The amount of wheat varies from 60 to 80 per cent but in Nigeria a 100 percent sorghum loaf has been made.

Attention is being given now to mixing wheat and legumes in flour to bring the protein content up to 20 per cent or more, compared with 13.5 per cent in wheat loaves.

Widespread interest in experiment

Mr. Hulse stresses the importance of making practical use in developing countries of whatever new is learned about the age-old process of making bread. Brazil, Colombia, Ghana, India, Peru and Senegal as well as Nigeria, have expressed interest in new bread-making methods. Observers from research institutes in Lebanon and Nigeria, will visit the University of



Technician Linda McConnell kneads dough made from composite flours at University of Manitoba laboratory.

Manitoba this summer as a first step in training instructors from developing countries in the new processes. In Maiduguri, Nigeria, younger women have shown they are eager to buy in co-ops and bazaars a widening range of new bread products made from wheat, corn, millet and sorghum, all grown locally. University of Alberta research workers are assisting in this application of techniques developed in Canada.

"As more people move into urban communities and as women become emancipated, bread becomes more and more a convenience food," asserts Mr. Hulse. "We're encouraging new techniques to make subsistence grains more attractive in developing countries."