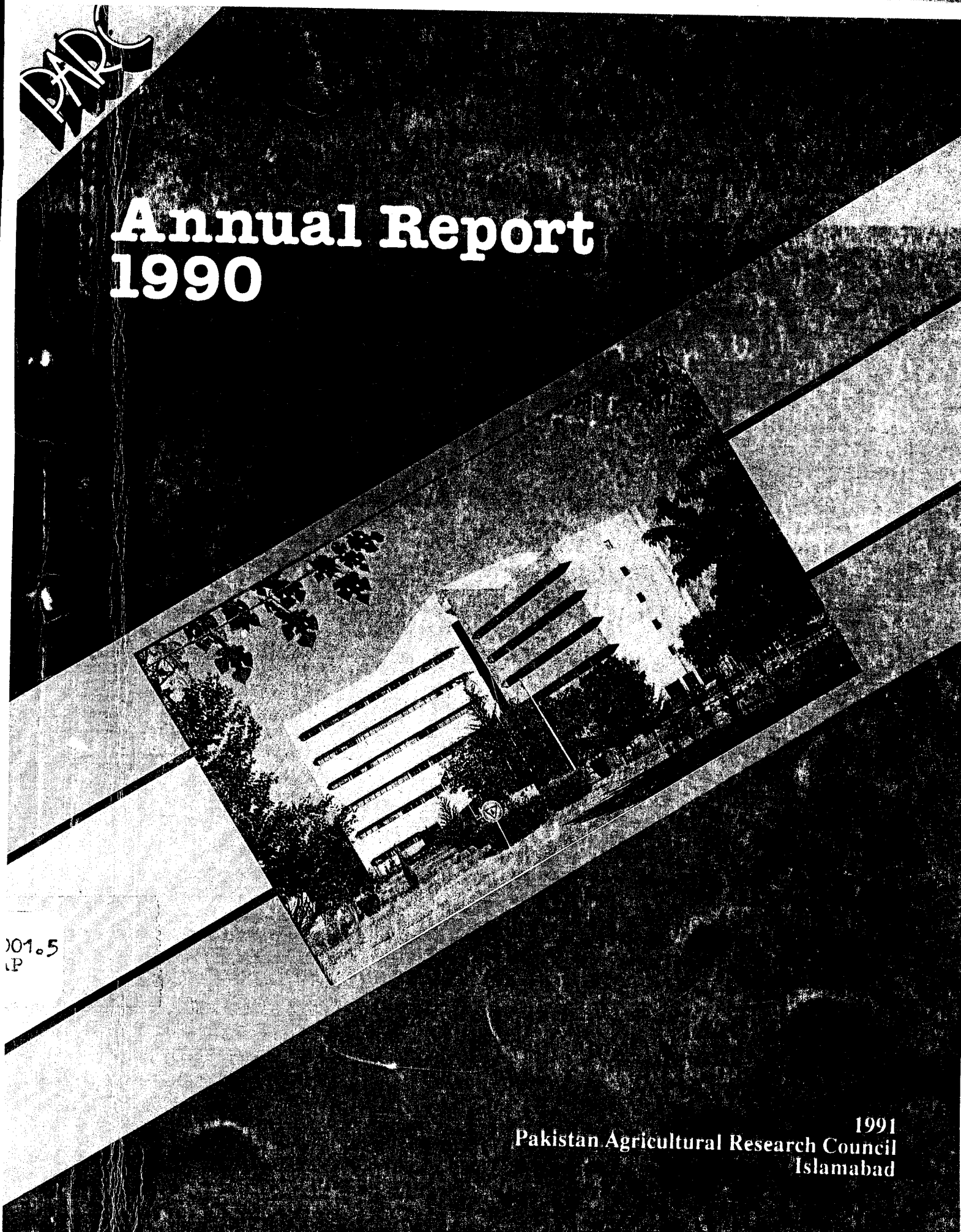

Annual Report 1990

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Food Technology Research

INTRODUCTION

Food Technology and Nutrition Research Laboratories were established in 1984 with the mandate to conduct quality research on food and nutrition problems related to agriculture in Pakistan. The goal is to incorporate nutritional considerations into the national agricultural policy and to make the farmer and the common man more conscious about the nutritive value of the food produced and consumed in this country, so that the farmer selects, for cultivation those crop varieties which not only give high yield per acre and are more resistant to disease but also have high nutritive values and consumer acceptance. This will ensure that the common man gets the best value for his money.

OBJECTIVES

1. Screen food crop varieties for nutritional quality and consumer acceptance.
2. Identify and resolve nutritional problems of selected crops and provide facilities and service support to the national agricultural research system.
3. Strengthen linkages with national and international institutions in developing collaborative research to solve priority food and nutrition problems and provide training/ workshop etc.
4. Provide analytical services to the plant and animal scientists working in provincial institutions.

ACHIEVEMENTS - 1990

- Over two hundred samples of wheat (advanced lines/ NUWYT) lines/varieties were tested for physico-chemical and nutritional quality.
- Samples of rice (early/advance lines) were screened for physico-chemical nutrition and cooking quality.
- Forty lines of chickpea, mung/ mash were screened for proximate analysis, phytic acid and tannin contents.
- Eight thousand samples of rapeseed and mustard, soybean, sunflower, safflower and groundnut were screened for different parameters such as (oil contents, fatty acid profile, protein contents, erucic acid and glucosinolates contents of respective samples).
- Technical support service were extended to private and public sector including milling and baking industries (Sihala Flour Mills, Roti Corporation etc.), oil mills (Punjab Oil Mill) and Food and Beverages Industries (Murree Brewery)
- A preliminary survey was also conducted to identify problems of the milling and baking industry and to develop collaboration with this sector to improve the quality of their products.
- Standardized quality specifications for refined low erucic acid rapeseed/mustard oil (Canola oil) and got approved by the Pakistan Standard Institution.
- Provided guidance and research facilities to post-graduate students of Agricultural Universities.

RESEARCH RESULTS

Evaluation of Early Lines of Rice (F_1) for Quality Profiles

Eight breeding lines (KS-282/JP-5, JP-5/KS-282, IR-2812-45-2/DR-83, Swat II/IR 25588-7-3-1, 28128-45-2, (KS-282/IR-28128-45-2)/ IR-28128-45-2 and Swat II/Arborio and two established rice cultivars (JP-5 and KS-282) grown at NARC were tested for their nutritional quality. The kernel length ranged from 5.61 mm in JP-5 to 7.51 mm in KS-282/IR 28128-45-2/IR 28128-45-2. Higher values for kernel breadth (3.10 mm) and kernel thickness (2.11 mm) while lower values for quality index (0.86) and elongation ratio (1.3) were found in JP-5. Both the varieties showed the same alkali spreading value (6) and low gelatinization temperature. Protein contents varied from 7.7 to 11.9 percent in JP-5/KS-282 and Swat II/IR 25588-7-3-1, respectively. Some lines showed sticky behaviour upon cooking like JP-5, while trend in others was like KS-282. It was inferred that lines DR-83/IR 28128-45-2 and (KS-282/IR 28128-45-2)/IR 28128-45-2 exhibited better performance than KS-282 for grain size, quality index, cooked keernel length and elongation ratio and were at par in cooking and eating qualities. Similar trend was also observed in liens KS-282/JP-5 and JP-5/KS-282 when compared to JP-5.

Yield and Physicochemcial Characteristics of Rice as Affected by Different Levels of Nitrogen Fertilizer

Two commercial IRRI type rice varieties (IR-6 and DR-83) grown at Jammra, Sindh, were analysed for their quality parameters. The total rice yield ranged from 2670.0 to 5787.6 and 1471.7 to 3524.7 kg/ha in IR-6 and DR-83, respectively. However, DR-83 gave lower yield (1957.8 kg/ha) with higher N/level which may be due to crop lodging and some other factors. Protein content varied from 6.52 to 7.05 and 7.24 to 9.85

tively, due to consistent increase in N levels. Protein yield exhibited the same trend as was found in the total rice yield. Elongation ratio differed from 1.82 to 1.85 and 1.57 to 1.63, in IR-6 and DR-83, respectively. All the samples of IR-6 and DR-83 fertilized with different N levels scored 7 and 3 alkali spreading (AS) values and had low and high gelatinization temperature (GT), respectively. A numerical scale of 1-7 was used for AS and negative correlationship existed between AS and GT. No significant differences were observed in physical dimensions like the kernel length, breadth, thickness and quality index. It was inferred that IR-6 was more responsive to nitrogenous fertilizer than DR-83.

Effect of Plant Spacing on Yield and Physicochemcial Characteristics of Rice Grain

Three rice varieties (IR-6, DR-83 and Lateefy) grown with different spacing at Jammra, Sindh, were analyzed for rice yield and grain quality parameters. The data showed that higher protein content values for IR-6 (6.60%), DR-83 (8.59%) and Lateefy (7.91%) were found in T_1 (15cm x 20cm spacing). It was probably due to more efficient N-fertilizer utilization. Similarly, higher rice yield for IR-6 (4898.0 kg/ha), DR-83 (3604.6 kg/ha) and Lateefy (2751.6 kg/ha) were obtained in T_2 (20cm x 20cm spacing). It was presumably due to collective effect of fertilizer efficiency and photosynthetic activities. Gel consistency values of all the varieties in all the treatments were classified as "intermediate" because those ranged between 40 and 60 cm. Progressive increase in amylose content was observed in T_1, T_2, T_3 and T_4, respectively. So far, radiation during grain ripening may contribute to the phonemenon. The IR-6 and Lateefy had low, while DR-83 high gelatinization temperature on alkali spreading basis in all the treatments. Protein yield values were also found higher for all the varieties in T_2. Therefore, the treatment was better than others.

Quality Evaluation of National Uniform Wheat Yield Trials

The NUWYT entries were also grown and evaluated for quality characteristics at NARC during 1989-90. The test weight, hardness, flour extraction, flour ash, whole grain protein contents, dry gluten content, alpha amylase activity, and mixing behaviour of dough were determined. *Chapati* baking test was conducted on 90 ± 4% flour according to the method standardized at NARC Labs. Organoleptic evaluation of the baked product was based on flour attributes, i.e., aroma, taste, texture and colour. However, emphasis was given to the later two for reporting overall *chapati* quality.

Effect of Processing on Phytate Contents of Chickpea

Phytate contents were determined in four *desi* chickpea varieties/lines i.e., CM-72, HC-202-6-1, C-141 and CM-87 grown at NARC, Islamabad. The dry seeds were subjected to different processing methods, including soaking, germination and cooking. Cooking of unsoaked and overnight soaked seeds reduced the phytate content from 7.4% in CM-87 to 9.5% in HC-202-6-1 and 2.7% in CM-87 to 4.1% in HC-202-6-1, respectively. In soaked-cooked seeds, the reduction in phytate contents was found to be 14.4% in C-141 to 17.8% in HG-202-6-1. The phytate contents were reduced to the maximum extent in germinated raw and cooked seeds of all the chickpea varieties (33.1% in CM-72 to 38.6% in HG-202-6-1 in raw germinated and 40.9% in CM-72 to 46.5% in HG-202-6-1 of germinated-cooked seeds respectively.

Germination of the seeds appeared to be a relatively simple non-chemical approach for decreasing the phytic acid levels. The phytates in legumes interfere in the utilization of mineral elements. It is recommended that cooking of sprouted grains of chickpeas should be encouraged.

Changes in Chemical Composition of Sunflower Seed during Maturation

The relation of days after flowering to chemical composition and physiological maturity of sunflower (variety NK-212) was studied at NARC, Islamabad. The planting was done in April, 1990. At the initiation of flowering, about 200 plants were tagged. The heads were hand-harvested after every two days from 4 to 40 days after flowering. Seeds from the heads were removed by hand, cleaned, sun-dried and analysed for moisture, oil, protein and fatty acids. The oil contents were found negligible up to eight days after flowering and then increased steadily, and were 32.6% after 16 days after flowering. About 40.7% oil was found in the samples 26 days after flowering. Protein synthesis began at an early stage, and 20.7% protein was found in the samples collected four days after flowering when oil contents were only 1.7%. There was no obvious increase in protein contents afterward. The 100-seed weight increased gradually with increase in days after maturity. Palmitic acid and oleic acids were highest in the beginning, that decreased gradually with the passage of time, while linoleic acid increased gradually. The data showed that desaturation of oil occurred during maturity.

Technological Value of NUWYT Samples from CCRI

Ten NUWYT samples were received from Cereal Crop Research Institute (CCRI), Pirsabak, were analysed. The range for thousand kernel weight and test weight was 39.1-49.0g and 73.8-79.2 kg/hl respectively. The break flour ranged from 18.2 to 32.0 percent, while reduction flour ranged from 36.4 to 54.8 percent. Falling number ranged from 224 to 436 second. The protein content ranged from 10.0 to 13.0 percent and 11.4 to 14.6 percent, for white flour and whole meal flour respectively. Ash contents ranged from 0.39 to 0.82 percent and 1.8 to 2.2 percent in white and whole meal flour, respectively. Water absorption was from 65.5 to 69.6 percent. Stability and dough development time ranged from 1.8 to 10.5 minutes and 4.0 to 8.5 minutes, respectively. Time

breakdown ranged from 6.5 to 16.0 minutes.

Nutritional Value of Wheat from Quetta

Sixteen wheat samples received from ARI, Sariab, Quetta, were studied for texture, grain colour, 1000 kw, moisture, protein and ash contents. Thousand kernel weight ranged between 18.8 and 29.2 g. Protein and ash ranged from 15.0 to 20.1 percent and 1.3 to 2.1 percent, respectively.

Two wheat samples from AZRI, Quetta, were tested for psi, 1000 kernel weight, moisture, protein and ash contents. One sample was plump and the other was shrivelled. Protein and ash contents of shrivelled sample were much higher as compared to the sample with plump grains.

Screening of Oilseeds for Oil Contents

About 2539 samples of rapeseed, 91 of soybean, 2381 of sunflower, 20 of groundnut and 219 of safflwoer, obtained from respective programmes at NARC, were analyzed for oil contents. The results showed that oil content in rapeseed samples varied between 21.0% and 53.3%, with a mean value of 44.2%. The oil in sunflower varied between 7.7% and 55.6%, with a mean value of 39.8%. Similarly, range and mean values of groundnut, soybean and safflower were also determined.

Glucosinolate Contents of Rapeseed and Mustard

In rapeseed and mustard, higher levels of glucosinolates result in the release of sulphur that acts as an antagonist for catalyst used in the hydrogenation of edible oils. High glucosinolates in the meal also cause health hazards when it is used in poultry feed. During 1990, 2544 samples of rapeseed and mustard breeding material were analysed for total glucosinolate. The material ranged form 14.2 l moles/g seed to 169.9 l moles/g seed. Efforts are being made to achieve a level of 20-30 l moles/g seed.

varieties such as Westar with low glucosinolate and erucic acid contents is being encouraged. An extensive programme, called Canola Maximization Programme is in full swing at different locations viz., Mangial, Fatehjang and BARD Project area at NARC. The material received from these locations was assessed for erucic acid, total glucosinolates and oil contents.

Development of Low Erucic Acid Varieties by Pedigree Selection

Under this programme, 572 samples received from the BARD Project and 100 samples received from the National Oilseed Development Programme, NARC, were analysed for erucic acid contents, so that the breeding materials may be screened for the selection of low erucic acid varieties.

Effect of Fertilizer Application Methods on Chemical Composition of Rice Nursery

Rice nursery was grown at NARC by applying three different methods of fertilizer. The samples were collected at different dates (weekly) when the nursery was about to be transplanted in triplicate, and analyzed for fat, protein and ash contents.

The results showed that on first date of sampling i.e., June 26, 1990, M_3 (10 g urea + 10 g DAP/m^2 as basal dose + 10 g urea + 10 g DAP/m^2 as broadcast) was found to be the best as percentage of fat and protein was maximum (2.49% and 21.25%). The M_3 was also found to be the best in samples collected on D_2 i.e., July 1, 1990, in which percentage fat and protein was maximum (2.83 and 1988). The results also showed that effect of methods of fertilizer application by broadcasting or as liquid spray on rice nursery were positive but temporary on fat and protein contents of the nursery plants.

Effect of Rice Husk Ash Application

NARC by applying three different doses of husk ash. The samples were collected at different dates (weekly) and were transplanted in triplicate. They were analyzed for fat, protein and ash contents.

The data showed that application of rice husk ash had no significant effect on the protein and fat contents of the nursery, while the mineral contents of nursery increased significantly for a limited period.

Effect of Fertilizer Doses on Chemical Composition of Rice Nursery

Rice nursery was grown at NARC by applying three different fertilizer doses. The samples were collected at different dates (weekly), when the nursery was about to be transplanted in triplicate, and analyzed for protein, fat and ash contents. The data showed that variation in fertilizer doses had no effect on the fat contents of the nursery. Protein contents of the nursery were directly related to the amount of fertilizer added and more nitrogen was found in the samples collected at an early date than those collected later. Ash contents of the nursery increased gradually with the passage of time and there was no obvious difference in mineral contents due to the amount of fertilizer added.

Nutritive Value of Some Sorghum Varieties

The nutritional quality of seven sorghum varieties (DS-75, IC-1039, Pak SS-II, Giza-3, Bagdar, PU-7 and BR-123) grown at NARC, Islamabad, was determined. The tannin contents ranged from 151 mg/100g in Giza-3 to 548 mg/100g in BR-123. The colour of the seed was well correlated with tannin contents (off-white varieties had lower tannin contents and the brown one had higher contents). Protein contents ranged from 10.2% in DS-75 to 13.6% in BR-123. Ash contents ranged from 1.6% in IC-1039 to 2.2% in Giza-3.

in Pak-SS-II and DS-75 (3.2g per 16g N) BR-123 contained minimum lysine contents (2.5g per 16g N) among the analysed varieties. The iron contents ranged from 6.9 mg/100g in Pak SS-II to 9.9 mg/100g in IC-1039. Zinc contents ranged from 2.5 mg/100g in PU-7 to 3.7 mg/100g in DS-75. Maganese contents ranged from 1.1 mg/100g to 2.3 mg/100g. DS-75 contained maximum copper (2.7 mg/100g) while Pak SS-II contained the minimum (0.7 mg/100g). Sodium and potassium varied from 57.3 mg/100g to 76.1 mg/100g and 396.5 mg/100g to 504.6 mg/100g, respectively.

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