# Development of IEC modules for the promotion of three local pearl millet preparations to improve the knowledge w.r.t. Pearl Millet consumption among the rural population of Nagaur district of Rajasthan

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**Funding Agency: ICMR, Translational Research Cell**

**Indian Council of Medical Research**

**Desert Medicine Research Center**

**Jodhpur - 342 005**

# C o n t e n t s

1. **Title of the Project: Development of IEC modules for the promotion of three local pearl millet preparations to improve the knowledge w.r.t. Pearl Millet consumption among the rural population of Nagaur district of Rajasthan**

2. **Principal Investigators:** **Dr. Madhu Bala Singh, Scientist G**
   Desert Medicine Research Centre, New Pali Road,
   Jodhpur, Pin- 342 005, Rajasthan, India

   **Co-Principal Investigators:** Dr. Ranjana Fotedar, Scientist 'D'

3. **Implementing Institution:** Indian Council of Medical Research
   Desert Medicine Research Centre,
   New Pali Road, Jodhpur, Pin- 342 005, Rajasthan

   **Collaboration:** ICDS Department, Nagaur District, Rajasthan

   **Funding Agency:** Translational Research Cell,
   Indian Council of Medical Research,
   New Delhi

4. **Date of Commencement:** January, 2016

5. **Duration:** Two years & half years

6. **Date of Completion:** 30th July, 2018

7. **Objectives as approved:**

**Primary Objectives:**

1) Development of IEC modules for promotion of three local pearl millet preparations viz. Rab1 (Pearl millet Grains), Kadhi and Sogra to improve the knowledge of the rural population w.r.t. to pearl millet consumption

2) Development of a range of educational materials highlighting health, nutrition & therapeutic values of different pearl millet preparation for improvement of dietary intake of Iron of the rural population

3) Improvement in the food practices of the rural population w.r.t. to local pearl millet preparations and to study the barriers, if any, related to it.

4) Assessment of IEC module developed for the promotion of three local pearl millet preparations with increase in their consumption pattern in their diet, as an outcome indicator.

**Secondary Objective:**

5) Estimation of Hb% before and after the intervention in both study and control groups so as to observe the improvement in anemia in women in the study group.

**8. Deviation made from original objectives if any, while implementing the project and Reasons thereof:** No

**9. Experimental work giving full details of experimental set up, methods adopted, data Collected supported by necessary tables, charts, diagrams and photographs**.

Pearl millet is a staple diet in desert areas, which is also an important dietary source of iron and zinc for the at risk populations in Indian states and districts of iron deficiency anemia, a nutritional deficiency of public health significance. The **results** of the **earlier project** on **'Study of food and nutrient consumption pattern in women of child bearing age and 6-59 months of age, with particular reference to Pearl millet consumption pattern and effects of storage, processing, & cooking practices on the retention of Iron, Zinc, Phytate and Polyphenols in Nagaur, a desert district of Rajasthan' (funded by HarvestPlus, Washington**) revealed that Pearl millet is main staple diet (63.0%) of rural areas of Nagaur district, followed by wheat (26.7%), revealing that it is a significant source of dietary energy and nutritional security for rural populations. In this study, at each village level Focus Group Discussions were conducted for collection of information regarding seasonal pattern and time trends in pearl millet production and consumption, traditional processing and cooking methods, etc. At each village level, focus group discussions were conducted from two types of key informant groups. First group of 6 or more male persons (key informants) mainly key persons from village i.e. Panch, Sarpanch, teacher etc from the village to provide the above mentioned information. Second group consisted of 6 or more knowledgeable women (key informants) including Aganwari workers for providing the information regarding the preparation of different type of recipes from pearl millet, their consumption and preservation etc. They also demonstrated the method of preparation of different recipes prepared from the pearl millet which were commonly consumed by the villagers. The Team learnt and standardized five commonly consumed recipes of pearl millet in the field in Nagaur district of Rajasthan. The samples of raw varieties of pearl Millet collected from field were taken by the project staff to laboratory of Baroda Pearl Millet Center (Department of Foods and Nutrition, A WHO collaborating Center for Health Promotion, Faculty of Family and Community Sciences, MS University of Baroda, Vadodara, Gujrat) for testing of iron, zinc, phytate, and polyphenol retention. Pearl Millet Project staff also prepared the five standardized recipes of pearl millet in the Baroda laboratory and dried them for testing to be done for above mentioned parameters.

This study revealed that five varieties of pearl millet were consumed in Nagaur district i.e. 'Desi bajra', 'Pro Agro hybrid', 'MH-169 (commonly consumed) and '118+154 Ghua Seed', and Pioneer' (Rarely consumed). The most common recipes prepared from pearl millet in the study villages were *Sogra*, *Rab1* (Pearl millet Grains), *Rab2* (Pearl millet Flour), *Kadhi* and *Khitchri* (*Kheech*). Five samples each of five cooked recipes mentioned above prepared from pearl millet in lab (commonly consumed by the villagers i.e. Desi bajra, Pro Agro hybrid, and MH-169), were tested for iron, zinc, phytate, and polyphenol retention. The study revealed that among the cooked recipes, retention of Zinc and Iron increased in *rab1* (Pearl millet Grains) preparation i.e. 3.64 to 4.40 mg/100g and 5.99 to 10.5mg/100g respectively. It was observed that the iron content in cooked samples ranged from 5.29-10.5mg/100g (highest in Rab1 (Pearl millet Grains) and lowest in Rab2 (Pearl millet Flour), with an average of 7.49mg/100g (Table 1). In case of Sogra, (Chapati made from pearl millet Flour), retention of Iron was more when prepared on iron Tawa (9.99mg/100g) in comparison to Mud

Tawa (6.31mg/100g) Results indicated that MH-169, Mixed flour and Desi Bajara varieties of pearl millet were observed to be good as the contents of total phenols and phytate were less and Iron was more in comparison to other varieties. In biochemical analysis, Phytate content shows that we have a really high Phy/Zn ratio, way above the 15 cut off value. This provides us with sufficient evidence to assume low bioavailability for both iron and zinc. Results of this study revealed that retention of Phytates and Phenols were reduced after cooking in most of the preparations where processes of Soaking, Pounding and Dehusking were involved, such as Rab1 (Pearl millet Grains), Khitchri and Kadhi. Combination of Rab1(Pearl millet Grains), Khitchri and Kadhi are good, where processes of Soaking, Pounding and Dehusking were involved due to which Iron retention was also found good. In addition to this, retention of Iron was more when Sogra was prepared on Iron Tawa in comparison to Mud Tawa.

**Table 1: Results of Zinc, Total Iron, Phytates and Total Phenols in Raw and Cooked Pearl Millet Based Recipes**

| S.No. | Food Sample | Zinc (Mg/100g) | Iron (Mg/100g) | PHYTATE (Mg/100g) | TOTAL PHENOL(Mg/100g) |
|---|---|---|---|---|---|
| **Raw varieties** | | | | | |
| 1 | 118+154 Ghua Seed | 3.25 | 4.60 | 467.2 | 380 |
| 2 | Desi bajra, District Nagaur | 3.39 | 4.89 | 468.2 | 340 |
| 3 | MH-169, District Nagaur | 2.34 | 5.99 | 322.8 | 120 |
| 4 | Pro Agro hybrid, District Nagaur | 2.65 | 4.90 | 537.0 | 370 |
| 5 | Pioneer | 3.29 | NA | 468.0 | 350 |
| 6 | Mixed Flour | 3.64 | 5.99 | 300.0 | 210 |
| | **Mean** | **3.09** | **5.24** | **427.3** | **295** |
| | **Range** | **2.34-3.64** | **4.60-5.99** | **300.8-537.0** | **120-380** |
| **Cooked Recipes/Preparations** | | | | | |
| 7 | Rab1 (Pearl millet Grains) | 4.40 | 10.5 | 200.5 | 270 |
| 8 | Rab2 (Pearl millet Flour) | 4.84 | 5.29 | 267.4 | 260 |
| 9 | Khitchri (Kheech) | 3.59 | 5.29 | 200.5 | 320 |
| 10 | Sogra | 3.89 | 9.99 (IT)<br>6.31 (MT) | 234.0 | 310 |
| 11 | Kadhi | 3.74 | 6.39 | 267.2 | 220 |
| | **Mean** | **4.09** | **7.49** | **233.9** | **276** |
| | **Range** | **3.59-4.84** | **5.29-10.5** | **200.5-267.4** | **220-320** |

According to WHO, at present, Iron and Vitamin A supplementation are the most common strategy currently used to control these deficiencies in developing countries for the time being. This is likely to remain the case until either significant improvements are made in the diets of entire populations or food fortification is achieved. This study tried to achieve this aim in which attempt have been made for the development of IEC modules for the promotion of different local pearl millet preparations which in turn will help in reduction of micronutrient deficiencies especially anemia among rural population of Nagaur district of Rajasthan, based on the findings of Pearl Millet project

**Study design:** Intervention study

**Sample size:** Study have been carried out in Nagaur, a desert district of Rajasthan. Cluster Randomized trial has been adopted for this study. Two clusters i.e. two tehsils of Nagaur district have been selected randomly. One cluster was for intervention group and 2nd cluster was control group. Sample size was calculated on the basis of consumption pattern of Rab1 (Pearl millet Grains), among women of desert area as reported in literature(Pearl millet Project Report by Singh *et al* 2011-12) as 15% rounded off to 20 percent (P1) and assuming to increase the percentage of consumption pattern of Rab1 (Pearl millet Grains), among women to be 30 percent (P2) in the group which has received intervention for one year, with confidence interval as 95% (as $\alpha$ is 0.5) and Power is 80 percent (1-$\beta$ as 0.8) using following formula:-

$$N \text{ (per group)} = 8 \times \frac{(p1\ q1 + p2\ q2)}{(p1 - p2)^2}$$

Sample size worked out to be 360 per group, adjusted for 20 percent non response. So total sample size was 720, rounded of to 800 from Nagaur district of Rajasthan i.e. 400 in control group and 400 in intervention group.

**Study subjects**: Respondent were women who were cooking food i.e. 15 years and above in Nagaur district of Rajasthan.

**Sampling and sampling strategy:** Nagaur district has ten tehsils as per census[3] 2011. Study was carried out in two clusters / tehsils of Nagaur district which was selected on the basis of feasibility, approachability and effective intervention. In one tehsil i.e Merta tehsil, control group was selected and in 2nd tehsil i.e. Khinvsar tehsil, intervention group was selected.

**Selection of villages**: From the selected two tehsils, six villages were to be selected i.e. three villages in each tehsil on the basis of simple random sampling technique for effective intervention. Three villages were selected from Khinvsar tehsil i.e. Dharnawas, Bhavanda and Akla, taken as intervention group to whom intensive intervention was given for one year. Three villages were selected initially in Merta tehsil taken as control group but required sample size was not completed in three villages so two more villages adjacent to selected villages were covered to fulfill the required sample size. These five villages were Sodas, Basni Siyacharnan, Dhadhasani, Shekhasani and Mangaliyawas in control group to whom general advice was given at the time of survey (Table 2 & Map). From each village, all the households, which have women in the child bearing (15-45 years) age, were selected using a complete list of all households in each village.

**Table 2: Distribution of women in Control & Intervention Group at Baseline Survey**

| Group | Village | Total Registered women at HH level |
|---|---|---|
| **Control (Merta tehsil)** | Sodas | 64 |
| | Basni Siyacharnan | 42 |
| | Dhadhasani | 82 |
| | Shekhasani | 93 |
| | Mangaliyawas | 124 |
| | | |
| **Intervention (Khinvsar tehsil)** | Dharnawas | 136 |
| | Bhavanda | 135 |
| | Akla | 136 |
| **TOTAL** | | **812** |

**Inclusion criteria:** A household was selected only if eligible women of child bearing age (15-45 years) were a member of the family.

**Exclusion criteria:** If a household has two eligible women of child bearing age (15-45 years) as a member of the family, then only one eligible woman who was present at the time of survey was selected. Eligible women who was suffering from any chronic disease and pregnant women was not included in the study.

All the registered women were interviewed / examined at household level

**Baseline survey:** All the subjects were interviewed for collection of following information:

1. Socio-Demographic profile.
2. Use of pearl millet products in their dietary habit.
3. Information regarding their knowledge w.r.t. preparations of different type of recipes from pearl millet which have more iron and zinc and their method of preparation.
4. Consumption pattern of different local Pearl millet preparations in their diet terms of their frequency observations.
5. Hemoglobin estimation using Cyanmethaemoglobin technique and classified according to WHO classification.

**In control group**, only general advice regarding the dietary modification stressing the role of enhancers and inhibitors in diet, useful preparations of pearl millet etc. was given at the time of survey.

**Intervention group:** One module was developed for intervention group in which three villages from Khinvsar tehsil were covered and intervention was given for one year.

**Module:** In this module, three villages were selected from Khinvsar tehsil of Nagaur district randomly with a population size of 1000. All the women in the child bearing (15-45 years) age from the selected villages were enrolled (which was come around 150 women as population size is 6.5 in rural area as per census, 2001) (Table 2). As per the ICDS program, one Aganwari worker (AW) is recruited on the population of 1000 size in rural areas.

Monthly training was to be provided to all the Aganwari workers/ ASHA workers of the selected villages at the block level where monthly meeting of the Lady Supervisors with Aganwari workers was to be held.

All the trained Aganwari / ASHA workers of the selected villages were then be requested for further dissemination of the knowledge to their respected areas of the selected villages under the supervision of research team. Each Aganwari worker disseminated the knowledge to all the registered women i.e. 135 women of child bearing age group, in selected house hold from their respective area and imparted the knowledge at house hold level once in a month under the supervision of research team. At the time of dissemination of the knowledge, Traditional mother-in-law/ old ladies, if present, were also taken care of while imparting the knowledge regarding the food preparations. This was continued for one year and visits were also quantified.

## Fig.1. Flow Chart of Survey

**Cluster Randomized Trial**

**Nagaur District**

|

| **One Cluster /One Tehsil** | **2nd Cluster /One Tehsil** |
|---|---|
| **Control Group**<br>**Merta Tehsil** | **Intervention group**<br>**Khinvsar Tehsil** |
| **Three Villages (135 women in each village)**<br>**Adjacent two villages taken to complete the adequate sample size** | **Three villages (135 women in each village)** |
| **Base line survey in 405 women** | **Base Line survey in 407 women** |
| | **Intervention for six months on Monthly basis** |
| **No Mid term survey** | **Mid term survey in 407 women** |
| | **Intervention for six months on monthly basis** |
| **Final survey for all parameters in 405 women** | **Final survey for all parameters in 407 women** |
| **Impact assessment of IEC module in Control group (CG)** | **Impact assessment IEC module in in Intervention group (IG)** |

**Intervention:**

**1. Nutritional councilling i.e. IEC** was provided to all the Aganwari / ASHA workers, in monthly block meeting of the Lady Supervisors with AWs twice, first in the beginning of the study and then after the completion of the baseline survey (two days in each training), regarding:-

**Dietary intake:**

- Therapeutic values of different pearl millet preparations for promotion of three local pearl millet preparations viz. Rab1 (Pearl millet Grains), Kadhi and Sogra to improve the knowledge of the rural population w.r.t. to pearl millet consumption which in turn will help in reduction of anemia.
- Knowledge regarding the preparations of different type of preparations / recipes from pearl millet viz. Rab1 (Pearl millet Grains), Kadhi and Sogra which have more retention of iron and zinc after cooking.
- IEC was provided regarding promotion of consumption of those preparations of pearl millet which have more retention of iron and zinc after cooking.
- In addition to the above knowledge regarding pearl millet, IEC was also provided to disseminate available scientific knowledge to the community for reduction of micronutrient deficiencies such as anemia/Zinc by means of dietary modification.

All the trained Aganwari / ASHA workers of the selected villages were requested for further dissemination of the knowledge to their respected areas of the selected villages under the supervision of research team.

**IEC was imparted by adopting the following three approaches:**

1. **Household level approach:** Each trained Aganwari / ASHA worker disseminated the knowledge to all the registered women (i.e. 135 women of child bearing age group, in selected house hold from their respective area) and imparted the knowledge at house hold level for three days in a month covering 45 women daily i.e. once in a month under the supervision of research team. At the time of dissemination of the knowledge, Traditional mother-in-law/ old ladies, if present, were also taken care of while imparting the knowledge regarding the food preparations. Intervention was continued for one year.

2. **Group approach:** Lectures were given by AW / ASHA worker monthly, at one place under the supervision of the research team along with group discussions in which all the women registered in the study area were invited for group discussion so as to do the effective dissemination of the knowledge at community level. In this approach, traditional mother-in-law/ old ladies available in the household of the registered women were also invited for interaction. In this approach, knowledge was imparted monthly for 1 day in each village and continued for one year.

3. **Mass approach:** Educational printed material, in local language, in the form of pamphlet, pictorials were also distributed to all registered women in the study area.

In addition to this, **quarterly meetings** of research team with CDPO, Aganwari workers / ASHA workers / Sahyogini etc. along with 10 main key persons from village i.e. Panch, Sarpanch, Ward Panch, teacher etc., were conducted for group discussion regarding the above mentioned

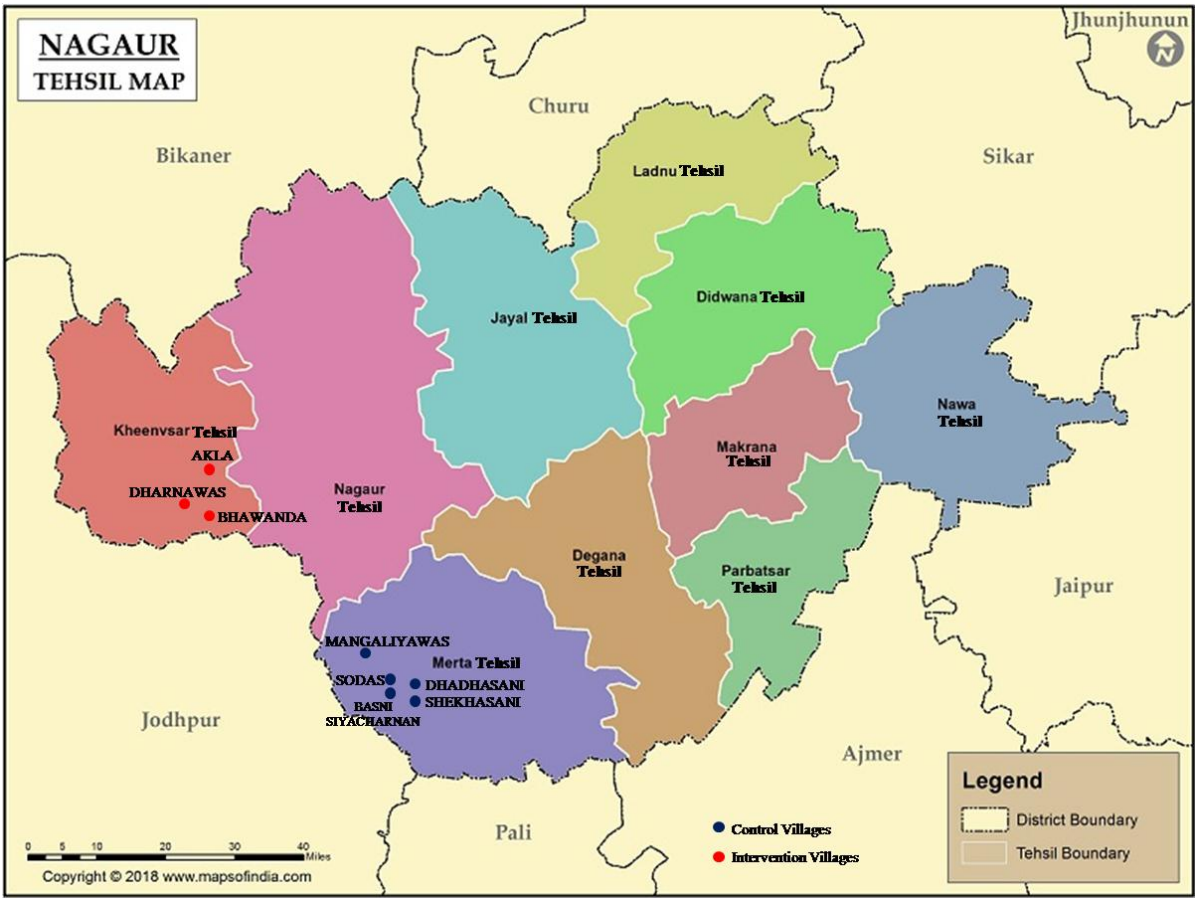
information of pearl millet so as to do the effective dissemination of the knowledge at community level. Quarterly meetings were conducted in all the 3 villages.

**Training of Aganwari / ASHA Workers:**

- Training was provided to all the AWs / ASHA workers twice, first in the beginning of the study and then after the completion of the baseline survey (two days in each training).
- Information regarding the importance of the study, their objectives and the knowledge regarding therapeutic values of three local pearl millet preparations viz. Rab1 (Pearl millet Grains), Kadhi and Sogra which in turn help in reduction of anemia; Knowledge regarding the preparations of three type of recipes from pearl millet, which have more retention of iron and zinc after cooking along with dietary intake modification, and micronutrient deficiencies was provided by means of lectures by PI and other experts in the field of nutrition and medicine.
- Knowledge was provided regarding promotion of consumption of those preparations of pearl millet viz. Rab1 (Pearl millet Grains), Kadhi and Sogra which have more retention of iron and zinc after cooking.
- In addition to the above knowledge regarding pearl millet, IEC was provided to disseminate available scientific knowledge to the community for reduction of micronutrient deficiencies such as anemia/Zinc by means of dietary modification.
- Educational material (printed in local language) was also distributed in the form of pamphlets and pictorials. Hands on training was given to them so that they can further impart this knowledge to all the women registered in the study area. Education modules were developed on the basis of the findings of the pearl millet project (completed earlier) in the form of pictorials, pamphlets and lectures.

After follow up of six months (Only in IG) and then after one year, all the registered women were examined again for all the parameters as done in the beginning of the study, in both the groups i.e. control and intervention group. Data was collected on their knowledge level regarding the therapeutic values of different pearl millet preparations, etc. and Consumption pattern of different local pearl millet preparations in their diet in terms of their frequency observation before and after the nutrition intervention from six villages, covering 812 households (Adult women) and thereafter comparison has been done to observe the impact of IEC module developed for the promotion of three local pearl millet preparations viz. Rab1 (Pearl millet Grains), Kadhi and Sogra, with increase in their consumption pattern in their diet in terms of their frequency observations as an outcome indicator along with enhancement, in terms of percentage, in their knowledge regarding the therapeutic values of different pearl millet preparations, their usage in their dietary habit along with their methods of cooking for the promotion of three local pearl millet preparations viz. Rab1 (Pearl millet Grains), Kadhi and Sogra which will help in improvement of dietary intake of Iron of the rural population which, in turn, help in reduction of anemia among rural population of Nagaur district of Rajasthan. Estimation of Hb% before and after the intervention in both study and control groups, as a secondary objective, was also done so as to observe the improvement in anemia in women in the study group.

**Map of Nagaur district showing villages covered in Khinvser (IG) &Merta (CG) Tehsil**



**Pictures depicting Intervention activities in study areas**

Meeting & Training – Merta & Khinvser tehsil

Intervention by Group & Mass approaches at Khinvser Tehsil (IG)


**Intervention by HHs, Group & Mass approaches at Khinvser Tehsil (IG)**



**Intervention by Group & Mass approaches at Khinvser Tehsil (IG)**


**Intervention by Group & Mass approaches at Khinvser Tehsil (IG)**

**Intervention by Group & Mass approaches at Khinvser Tehsil (IG)**


Intervention by Group & Mass approaches at Khinvser Tehsil (IG)





Rab 2 (Pearl Millet Grains) Preparation Process


**Pearl Millet & Sogra preparation**

**10. Detailed analysis of results indicating contributions made towards increasing the state of Knowledge in the subject**

This project was carried out in Nagaur district and sampling was done. Recommendation of Ethics Committee by DMRC was obtained. Meetings were conducted with Deputy Director, ICDS, Nagaur district along with CDPOs of Merta, Mundwa and Nagaur Tehsil informing them about the objectives of the project, nutrition intervention regarding the promotion of three local pearl millet preparations and the importance of the study and got their permission letters for Lady supervisors and Anganwadi workers to seek their cooperation during this study. Meetings were also conducted with all the Lady Supervisors of Khinvsar & Merta Tehsil and briefed them about the objectives of the project, nutrition intervention and importance of the study.

**First Training / Meeting** was conducted at Mundwa tehsil where all the Lady supervisors, ASHA/ AWS/ Sahyogini workers of Mundwa tehsil along with CDPO of Khinvsar and Mundwa Panchayat samiti were present. Another training was conducted at Khinvsar Block Center where Lady supervisor of Khinvsar and all the ASHA/ AW workers of Khinvsar tehsil were present (Photographs in Methodology part). In these trainings, knowledge was imparted regarding the objectives and importance of the study stressing following aspects:

- Therapeutic values of different pearl millet preparations for promotion of three local pearl millet preparations *viz.* Rab1 (Pearl millet Grains), Kadhi and Sogra to improve the knowledge of the rural population w.r.t. to pearl millet consumption which in turn will help in reduction of anemia.

- Knowledge regarding the preparations of different type of preparations / recipes from pearl millet *viz.* Rab1 (Pearl millet Grains), Kadhi and Sogra which have more retention of Iron and Zinc after cooking.

- Promotion of consumption of those preparations of pearl millet which have more retention of iron and zinc after cooking.

- In addition to the above knowledge regarding pearl millet, knowledge regarding the dietary modification was also imparted.

These trainings were conducted first in the beginning of the study. Besides these trainings, schedules were prepared, pretested in 40 household in three villages viz. Gudiya, Satlawas and Bhakrod of Khinvsar and Merta tehsils and finalized.

Baseline survey was completed and a total of 812 households (407 Intervention group & 405 Control group) were registered for the study, which had women in the child bearing (15-45 years) age (Table 2). All the subjects were interviewed for collection of following information:

1. Socio-Demographic profile.
2. Use of pearl millet products in their dietary habit.
3. Information regarding their knowledge w.r.t. preparations of different type of recipes from pearl millet which have more iron and zinc and their method of preparation.
4. Consumption pattern of different local Pearl millet preparations in their diet in terms of their frequency observations.
5. Hemoglobin estimation using Cyanmethaemoglobin technique and classified according to WHO classification.

In control group, only general advice regarding the dietary modification stressing the role of enhancers and inhibitors in diet, useful preparations of pearl millet, etc. was given at the time of survey.

Table 3 represents the Socio-demographic distribution of registered women (HHs) in Control and Intervention Groups in Merta and Khinvsar tehsils of Nagaur districts of Rajasthan at baseline survey. Analysis of 812 women (405 women in control group and 407 women in intervention group) showed that 94.6 to 96.8 percent were Hindus and 20.7 to 26.0 percent belong to Scheduled caste community. 15.2 to 26.6 percent women lives in joint families and nearly 85 percent households have electricity and36.5 to 40.5% sanitary latrines. Illiteracy was high (63.7 to 72.7%) and 73.8 to 78.8 percent belong to HW category, whereas, 15.8 to 23.8 percent were involved in Labourer occupation. 26.4 to 34.9 percent women were found belonging to MIG category (Income Rs 5000 to 9999). Regarding source of water, 32.4 to 40.7 percent women use tube well water and majority of women use fire-wood as cooking fuel (77.5 to 82.1%).

On the basis of BMI, it was observed that 26.1 to 29.1 percent women belong to Chronic Energy Deficiency, 51.9 to 57.0 percent in normal category, whereas, 16.9 to 19 percent in obese category (BMI >25) in CG and IG.

**Table 3: Socio-demographic distribution of women (HHs) in Control and Intervention Groups**

| Study Parameters | Control Group (N=405) | | Intervention Group (N=407) | |
|---|---|---|---|---|
| | No. of Registered women | Percent (%) | No. of Registered women | Percent (%) |
| **Age group- Years** | | | | |
| 15-25 | 122 | 30.1 | 133 | 32.7 |
| 26-35 | 150 | 37.1 | 183 | 44.9 |
| 36-45 | 133 | 32.8 | 91 | 22.4 |
| **Religion** | | | | |
| Hindu | 383 | 94.6 | 394 | 96.8 |
| Muslim | 22 | 5.4 | 13 | 3.2 |
| **Community** | | | | |
| Scheduled tribe | 19 | 4.7 | 33 | 8.1 |
| Scheduled caste | 84 | 20.7 | 106 | 26.0 |
| Backward caste | 268 | 66.2 | 225 | 55.3 |
| General caste | 34 | 8.4 | 43 | 10.6 |
| **Type of house** | | | | |
| Kuchha | 33 | 8.1 | 55 | 13.5 |
| Semi-pucca | 139 | 34.3 | 125 | 30.7 |
| Pucca | 233 | 57.6 | 227 | 55.8 |
| **Type of family** | | | | |
| Nuclear | 189 | 46.7 | 227 | 55.8 |
| Extended nuclear | 108 | 26.7 | 118 | 29 |

| | | | | |
|---|---|---|---|---|
| Joint | 108 | 26.6 | 62 | 15.2 |
| **Educational qualification** | | | | |
| Illiterate | 258 | 63.7 | 296 | 72.7 |
| Read and Write | 3 | 0.8 | 0 | 0 |
| 1 to 4 | 15 | 3.7 | 13 | 3.2 |
| 5 to 8 | 88 | 21.7 | 58 | 14.2 |
| 9 to 12 | 26 | 6.4 | 30 | 7.4 |
| College | 15 | 3.7 | 10 | 2.5 |
| **Occupation** | | | | |
| Laborer | 64 | 15.8 | 97 | 23.8 |
| Landlord | 3 | 0.7 | 0 | 0 |
| Tenant Cultivation | 4 | 1.0 | 2 | 0.5 |
| Service | 15 | 3.7 | 8 | 1.9 |
| Hw | 319 | 78.8 | 300 | 73.8 |
| **Income Rs.** | | | | |
| <2,000 | 11 | 2.7 | 9 | 2.2 |
| 2,000-4,999 | 48 | 11.9 | 48 | 11.8 |
| 5000-9,999 | 107 | 26.4 | 142 | 34.9 |
| ≥10,000 | 239 | 59.0 | 208 | 51.1 |
| **Electricity facility** | | | | |
| Yes | 346 | 85.4 | 346 | 85.0 |
| No | 59 | 14.6 | 61 | 15 |
| **Source of drinking water** | | | | |
| Open well | 21 | 5.2 | 1 | 0.3 |
| Tube well | 165 | 40.7 | 132 | 32.4 |
| Tap | 15 | 3.7 | 106 | 26.0 |
| Pound | 8 | 2.0 | 91 | 22.4 |
| Tanka | 196 | 48.4 | 77 | 18.9 |
| **Sanitary Kitchen** | | | | |
| Yes | 254 | 62.7 | 295 | 72.5 |
| No | 151 | 37.3 | 112 | 27.5 |
| **Type of cooking fuel** | | | | |
| Fire wood | 314 | 77.5 | 334 | 82.1 |
| LPG | 15 | 3.7 | 7 | 1.7 |
| FIRE+LPG | 76 | 18.8 | 66 | 16.2 |
| **Physiological status** | | | | |
| NPNL | 364 | 89.9 | 360 | 88.5 |
| LAC | 41 | 10.1 | 47 | 11.5 |
| **Activity status** | | | | |

| | | | | |
|---|---|---|---|---|
| Sedentary | 334 | 82.5 | 310 | 76.2 |
| Moderate | 71 | 17.5 | 97 | 23.8 |
| **Sanitary Latrine** | | | | |
| Yes | 148 | 36.5 | 165 | 40.5 |
| No | 257 | 63.5 | 242 | 59.5 |
| **Morbidity history** | | | | |
| Nil | 395 | 97.5 | 402 | 98.8 |
| Fever | 5 | 1.2 | 3 | 0.7 |
| Diarrhea | 2 | 0.5 | 1 | 0.3 |
| ARI | 2 | 0.5 | 1 | 0.2 |
| MAL | 1 | 0.3 | 0 | 0 |
| **BMI** | | | | |
| <18.5 | 118 | 29.1 | 106 | 26.1 |
| 18.5-24.99 | 210 | 51.9 | 232 | 57.0 |
| 25-29.99 | 67 | 16.5 | 55 | 13.5 |
| ≥30 | 10 | 2.5 | 14 | 3.4 |

Analysis of baseline survey exhibited that 29.1 and 75.4 percent women used Bajara grains as staple diet in Control Group (CG) and Intervention group (IG) respectively, whereas, 64.7 and 22.1 percent used Wheat and Bajara respectively due to their availability, affordability and taste. Frequency of preparation of Rab 1 from pearl millet grains daily was 0.3 percent and 2-3 times a week was 7.7percent and fortnightly, 10.9 percent in CG, whereas, 0.7 percent daily, 11.3 percent 2-3 times a week and 16.5 percent fortnightly by IG. Frequency of preparation of Rab 2 from pearl millet flour daily was 0.7 and 5.2 percent, 2-3 times was 17.8 and 26.8 percent and fortnightly, 12.1 and 11.8 percent in CG and IG respectively. Sogra was prepared 2-3 times a week by 12.4 and 10.2 percent and daily by 69.1 and 87.0 percent in CG and IG respectively. Kadhi was prepared 2-3 times a week by 29.4 and 25.3 percent and once a week by 29.9 and 56.3 percent in CG and IG respectively (Tables 7-18).

Analysis of baseline survey showed that the method used for preparing Rab was mainly from 'Grind to flour' by 65.2 and 70.5 percent, whereas, only 22.2 and 20.9 percent reported using 'Soak, pound and Dehusk' method in CG and IG respectively. The barrier for not using the 'Soak, pound and Dehusk' method was mainly reported to be labour (96.7 & 98.3% in CG and IG respectively, (Tables 19-20).

The knowledge regarding the value of Iron and Zinc retention in Rab 1 prepared from pearl millet grains and Sogra prepared on Iron Tawa and Kadhi was negligible in the baseline survey. They don't know the beneficial effects of Pearl millet products on anemia and health. Knowledge regarding the anemia, VAD, IDD was also found negligible.

After baseline survey, educational printed material was developed, in local language, in the form of pamphlets, flip charts and pictorials (Annexures I-III). Then in Intervention group area, 2nd training was conducted at Khinvsar Block Center, where Lady supervisor of Khinvsar and all the ASHA/ AW workers of Khinvsar tehsil were present and knowledge was imparted as given in the beginning.

Monthly intervention was done in Intervention Group, following three approaches i.e. House hold approach, Group approach and Mass approach.In addition to this, **quarterly meetings** of research team with CDPO, Aganwari workers / ASHA workers / Sahyogini, etc. along with 10 main key persons from village i.e. Panch, Sarpanch, Ward Panch, teacher, etc., have been conducted for group discussion regarding the above mentioned information of pearl millet so as to do the effective dissemination of the knowledge at community level.

**IEC was imparted by adopting the following three approaches:**

1. **Household level approach:** Each trained Aganwari / ASHA worker along with research team disseminated the knowledge to all the registered women of child bearing age group, in selected house holds from their respective areas and imparted the knowledge at house hold level for three days in a month. At the time of dissemination of the knowledge, Traditional mother-in-law/ old ladies, if present, were also taken care of while imparting the knowledge regarding the food preparations. Intervention continued for six months. Monthly Intervention coverage of registered Women in Intervention Group at household level according to Villages has been shown in Table 4.

2. **Group approach:** Lectures were given by research team along with AW / ASHA worker monthly, at one/more places and organized group discussions in which women registered in the study area were invited for group discussion so as to do the effective dissemination of the knowledge at community level. In this approach, traditional mother-in-law/ old ladies, and other key persons available in the households of the registered women were also invited for interaction. In this approach, knowledge was imparted monthly for 1-2 days in each village and continued for six months (Table 5).

3. **Mass approach:** Educational printed material, in local language, in the form of coloured pamphlets and pictorials were also distributed to all registered women in the study area. In addition to this coloured charts were also prepared and displayed by research team along with AW / ASHA workers monthly at schools and in the villages and disseminated the knowledge in community/ Mass level and clarified their quarries (Table 5).

In addition to this, **quarterly meetings** of research team with CDPO, Aganwari workers / ASHA workers / Sahyogini, etc. along with 8-10 main key persons from village i.e. Panch, Sarpanch, Ward Panch, teacher etc., were also conducted for group discussion regarding the above mentioned information of pearl millet so as to do the effective dissemination of the knowledge at community level. Quarterly meetings were also conducted in all the 3 villages of Intervention group (Table 5).

After six months again midterm survey was conducted on use of pearl millet products in their dietary habit, Information regarding their knowledge w.r.t. preparations of different type of recipes from pearl millet which have more iron and zinc and their method of preparation. Non Response rate was 4.4 percent in Mid term survey. Mid term survey data was analyzed so as to observe the effect of intervention in IG.

After mid term survey again monthly nutrition intervention was started in the intervention villages and continued for six months following three approaches i.e. House hold approach, Group approach and Mass approach as mentioned above. In addition to this, **quarterly meetings** of research team with CDPO, Aganwari workers / ASHA workers / Sahyogini etc. along with 8-10 main key persons from village i.e. Panch, Sarpanch, Ward Panch, teacher, etc., were conducted for group discussion regarding the above mentioned information of pearl millet so as to do the effective dissemination of the knowledge at community level as done earlier. The coverage of respondents during intervention ranges from 69.8 to 91.2 percent as mentioned in Table 4.

**Table 4. Monthly Intervention coverage of registered Women in Intervention Group at household level Village-wise**

| S. No. | Intervention Months | Study Villages (IG) | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | Dharnawas N =136 | | Bhavanda N=135 | | Akla N=136 | | Total N= 407 | |
| | | Available | NA | Available | NA | Available | NA | Available | NA |
| 1. | July, 2016 | 125 | 11 | 121 | 14 | 125 | 11 | 371 (91.2%) | 36(8.8%) |
| 2. | August, 2016 | 108 | 28 | 122 | 13 | 126 | 10 | 356(87.5%) | 51(12.5%) |
| 3. | September, 2016 | 115 | 21 | 112 | 23 | 117 | 19 | 344(84.5%) | 63(15.5%) |
| 4. | October, 2016 | 103 | 33 | 99 | 36 | 98 | 38 | 300(73.7%) | 107(26.3%) |
| 5. | November, 2016 | 110 | 26 | 102 | 33 | 100 | 36 | 312(76.7%) | 95 (23.3%) |
| 6. | December, 2016 | 111 | 25 | 100 | 35 | 114 | 22 | 325(79.9%) | 82 (20.1%) |
| 7. | **January, 2017** | **Mid-term Survey** | | | | | | | |
| 8. | February, 2017 | 118 | 18 | 121 | 14 | 114 | 22 | 353(86.7%) | 54 (13.3%) |
| 9. | March, 2017 | 119 | 17 | 115 | 20 | 114 | 22 | 348(85.5%) | 59 (14.5%) |
| 10. | April, 2017 | 115 | 21 | 110 | 25 | 119 | 17 | 344(84.5%) | 63 (15.5%) |
| 11. | May, 2017 | 114 | 22 | 113 | 22 | 104 | 32 | 331(81.3%) | 76 (18.7%) |
| 12 | June, 2017 | 109 | 27 | 114 | 21 | 105 | 31 | 328 (80.6%) | 79 (19.4%) |
| 13 | July, 2017 | 83 | 53 | 95 | 40 | 106 | 30 | 284 (69.8%) | 123 (30.2%) |
| 14 | **Post Intervention data Collection** | | | | | | | | |

**Table 5. Monthly Coverage of Individuals in Mass Meetings & Quarterly Meetings in Intervention Group**

| S. No. | Intervention Months | Individuals covered - Intervention Group Villages | | |
|---|---|---|---|---|
| | | Monthly Mass Meetings | Quarterly Meetings | |
| 1. | July, 2016 | 70 | | |
| 2. | August, 2016 | 720 | | |
| 3. | September, 2016 | 370 | | |
| 4. | October, 2016 | 285 | | |
| 5. | November, 2016 | 390 | November, 2016 | 75 |
| 6. | December, 2016 | 225 | | |
| 7. | **January, 2017** | **Mid-term Survey** | | |
| 8. | February, 2017 | 285 | | |
| 9. | March, 2017 | 200 | | |
| 10. | April, 2017 | 200 | April, 2017 | 80 |
| 11. | May, 2017 | 198 | | |
| 12 | June, 2017 | 204 | | |
| 13 | July, 2017 | 213 | | |
| 14. | **Total Covered** | **3360** | | **155** |
| | **Post Intervention data Collection** | | | |

After intervention for six months beyond mid survey, post intervention data was collected from all the respondents as registered earlier in the intervention and control group villages on all parameters as done in the beginning (Table 6). The Non response/ Non availability was 18.5 percent in control group, whereas, 16.2 percent in intervention group.

**Table 6: Distribution of Households covered during post intervention**

| Group | Village | Total Registered women at HH level |
|---|---|---|
| **Control**<br>**Merta tehsil N=330** | Sodas | 59 |
| | Basni Siyacharnan | 35 |
| | Dhadhasani | 68 |
| | Shekhasani | 77 |
| | Mangaliyawas | 91 |
| | | |
| **Intervention**<br>**Khinvsar tehsil N=341** | Dharnawas | 116 |
| | Bhavanda | 110 |
| | Akla | 115 |
| **TOTAL** | | **671** |

After this, data entry, its analysis and comparison was done among the IG group and also with CG group.

Analysis of Post intervention survey in IG and CG (without Intervention) showed that 5.5 and 70.1 percent used Bajara grains as staple diet in Control Group (CG) and Intervention group (IG) respectively, whereas, 93.0 and 29.0 percent used Wheat and Bajara by CG and IG respectively due to its availability, affordability and taste (Tables 7-10).

The results of baseline survey were compared with Post Intervention survey in both IG and CG. The comparison of frequency of preparation of Rab 1 from pearl millet grains 2-3 times a week has increased from 11.3 to 31.7 percent, Once a week from 10.8 to 25.2 percent, decreased fortnightly from 16.5 to 12 percent in IG after intervention. In CG which received no intervention, showed that frequency of preparation of Rab 1 from pearl millet grains 2-3 times a week has decreased from 7.7 to 2.7 percent, whereas, slight incline in Once a week from 11.1 to 11.8 percent, fortnightly from 10.9 to 21.8 percent. Overall in IG, frequency of preparation of Rab 1 from pearl millet grains up to fort nightly, increased significantly ($P<0.05$) from 39.3 to 73 percent indicating good impact of intervention, which is an outcome indicator in this study, whereas, in CG, slight incline from 30 to 36.3 percent was noticed (Tables 11-12 & Fig. 2).

The comparison of frequency of preparation of Rab 2 from pearl millet flour 2-3 times a week has decreased from 26.8 to 24.3 percent and Once a week from 28.8 to 22.9 percent, slight incline in fortnightly from 11.8 to 13.8 percent in IG after intervention as in Rab 2, process of Soaking, Pounding, & dehusking is not involved. In CG which received no intervention, showed that frequency of preparation of Rab 2 from pearl millet flour 2-3 times a week has decreased from 17.8 to 12.1 percent, whereas, inclined in Once a week from 17 to 25.5 percent, fortnightly from 12.1 to 20.3 percent. Overall in IG, frequency of preparation of Rab 2 from pearl millet flour up to fort nightly, decreased sharply from 72.6 to 69.2 percent indicating good impact of intervention as Rab2 was discouraged during intervention, whereas, in CG, inclined from 47.6 to 60.9 percent is being noticed (Tables 13-14).

**Table 7: Percent Usage of Staple grains of the households in Intervention Group**

| | Base Line | | Mid Term | | Post Intervention | |
|---|---|---|---|---|---|---|
| **Staple grains** | **No. of RW** | **Percent (%)** | **No. of RW** | **Percent (%)** | **No. of RW** | **Percent (%)** |
| Bajra | 307 | 75.4 | 354 | 91 | 239 | 70.1 |
| Wheat | 10 | 2.5 | 3 | 0.8 | 3 | 0.9 |
| W+B | 90 | 22.1 | 32 | 8.2 | 99 | 29.0 |
| **Total** | **407** | **100** | **389** | **100** | **341** | **100** |

The result is significant at p <0.05

**Table 8: Percent Usage of Staple grains of the households in Control Group**

| | Control Group (Base Line) | | Control Group (Final) | |
|---|---|---|---|---|
| **Staple grains** | **No. of RW** | **Percent (%)** | **No. of RW** | **Percent (%)** |
| Bajra | 118 | 29.1 | 18 | 5.5 |
| Wheat | 25 | 6.2 | 5 | 1.5 |
| W+B | 262 | 64.7 | 307 | 93.0 |
| **Total** | **405** | **100** | **330** | 100 |

The result is significant at p <0.05

**Table 9: Reason for selecting PM as staple grain in Intervention Group**

| **Reason for selecting PM as staple grain** | **No. of HH (Base Line) N= 407** | | | | **No. of HH (Mid Term) N= 389** | | | | **No. of HH (Post Intervention) N= 341** | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **Yes** | **(%)** | **No** | **(%)** | **Yes** | **(%)** | **No** | **(%)** | **Yes** | **(%)** | **No** | **(%)** |
| Availability | 327 | 80.3 | 80 | 19.7 | 287 | 73.8 | 102 | 26.2 | 235 | 68.9 | 106 | 31.1 |
| Affordability | 44 | 10.8 | 363 | 89.2 | 11 | 2.8 | 378 | 97.2 | 10 | 2.9 | 331 | 97.1 |
| Nutritious | 2 | 0.5 | 405 | 99.5 | 39 | 10.0 | 350 | 90.0 | 88 | 25.8 | 253 | 74.2 |
| Taste | 221 | 54.3 | 186 | 45.7 | 344 | 88.4 | 45 | 11.6 | 298 | 87.4 | 43 | 12.6 |

The result is significant at p <0.05

**Table 10: Reason for selecting PM as staple grain in Control Group**

| Reason for selecting PM as staple grain | No. of HH Control Group (Base Line) N= 405 | | | | No. of HH Control Group (Final) N= 330 | | | |
|---|---|---|---|---|---|---|---|---|
| | Yes | Percent (%) | No | Percent (%) | Yes | Percent (%) | No | Percent (%) |
| Availability | 192 | 47.4 | 213 | 52.6 | 216 | 65.5 | 114 | 34.5 |
| Affordability | 33 | 8.2 | 372 | 91.8 | 13 | 3.9 | 317 | 96.1 |
| Nutritious | 3 | 0.7 | 402 | 99.3 | 80 | 24.2 | 250 | 75.8 |
| Taste | 243 | 60 | 162 | 40 | 294 | 89.1 | 36 | 10.9 |

The result is significant at $p < 0.05$

The comparison of frequency of preparation of Kadhi prepared 2-3 times a week increased from 25.3 to 55.1 percent and decreased once a week from 56.3 to 36.1 percent in IG, which received intervention revealing good impact of intervention. In CG, frequency of preparation of Kadhi prepared 2-3 times a week decreased from 29.4 to 22.1 percent and increased once a week from 29.9 to 34.8 percent, which received no intervention revealing good impact of intervention (Tables 15-16). Overall in IG group, frequency of preparing Kadhi with Bajara flour increased significantly from 81.6 to 91.2 percent ($P < 0.05$), whereas, in Control Group, declined from 59.3 to 56.9 percent (Fig. 3).

The comparison of frequency of preparation of Sogra prepared daily increased from 87.0 to 97.9 percent and decreased 2-3 times a week from 10.2 to 0.9 percent and once a week from 1.5 to 0.3 percent in IG which received intervention revealing good impact of intervention. In CG, frequency of preparation of Sogra prepared daily increased from 69.1 to 87.6 percent and decreased 2-3 times a week from 12.4 to 5.8 percent and once a week from 4.4 to 3.6 percent (Tables 17-18 & Fig. 4). This showed a good impact of intervention in IG in promotion of three pearl millet preparations i.e. Rab 1 (Bajra grains), Sogra and Kadhi which were taken as outcome indicator.

**Table 11: Frequency of preparing *Rab* with bajra grains (*Rab*1) in Intervention Group**

| | Base Line | | | Mid Term | | Post Intervention | | |
|---|---|---|---|---|---|---|---|---|
| Frequency of Rab1 | No. of RW | Percent (%) | | No. of RW | Percent (%) | No. of RW | Percent (%) | |
| Daily | 3 | 0.7 | **39.3** | 10 | 2.6 | 14 | 4.1 | **73.0** |
| 2-3 times a week | 46 | 11.3 | | 108 | 27.8 | 108 | 31.7 | |
| Once a week | 44 | 10.8 | | 118 | 30.3 | 46 | 25.2 | |
| Fort Nightly | 67 | 16.5 | | 39 | 10.0 | 41 | 12.0 | |
| Seasonal | 22 | 5.4 | | 13 | 3.3 | 13 | 3.8 | |
| Rarely | 42 | 10.3 | | 26 | 6.7 | 24 | 7.1 | |
| Never | 183 | 45.0 | | 75 | 19.3 | 55 | 16.1 | |
| **Total** | **407** | **100** | | **389** | **100** | **341** | 100 | |

The result is significant at $p < 0.05$

**Table12: Frequency of preparing *Rab* with bajra grains (*Rab*1) in Control Group**

| | Control Group (Base Line) | | | Control Group (Final) | | |
|---|---|---|---|---|---|---|
| **Frequency of Rab1** | **No. Of HH** | **Percent (%)** | | **No. Of HH** | **Percent (%)** | |
| Daily | 1 | 0.3 | **30.0** | 0 | 0 | **36.3** |
| 2-3 timesa week | 31 | 7.7 | | 9 | 2.7 | |
| Once a week | 45 | 11.1 | | 39 | 11.8 | |
| Fort Nightly | 44 | 10.9 | | 72 | 21.8 | |
| Seasonal | 31 | 7.7 | | 36 | 10.9 | |
| Rarely | 86 | 21.2 | | 65 | 19.7 | |
| Never | 167 | 41.1 | | 109 | 33.1 | |
| **Total** | **405** | **100** | | **330** | 100 | |

The result is significant at p <0.05

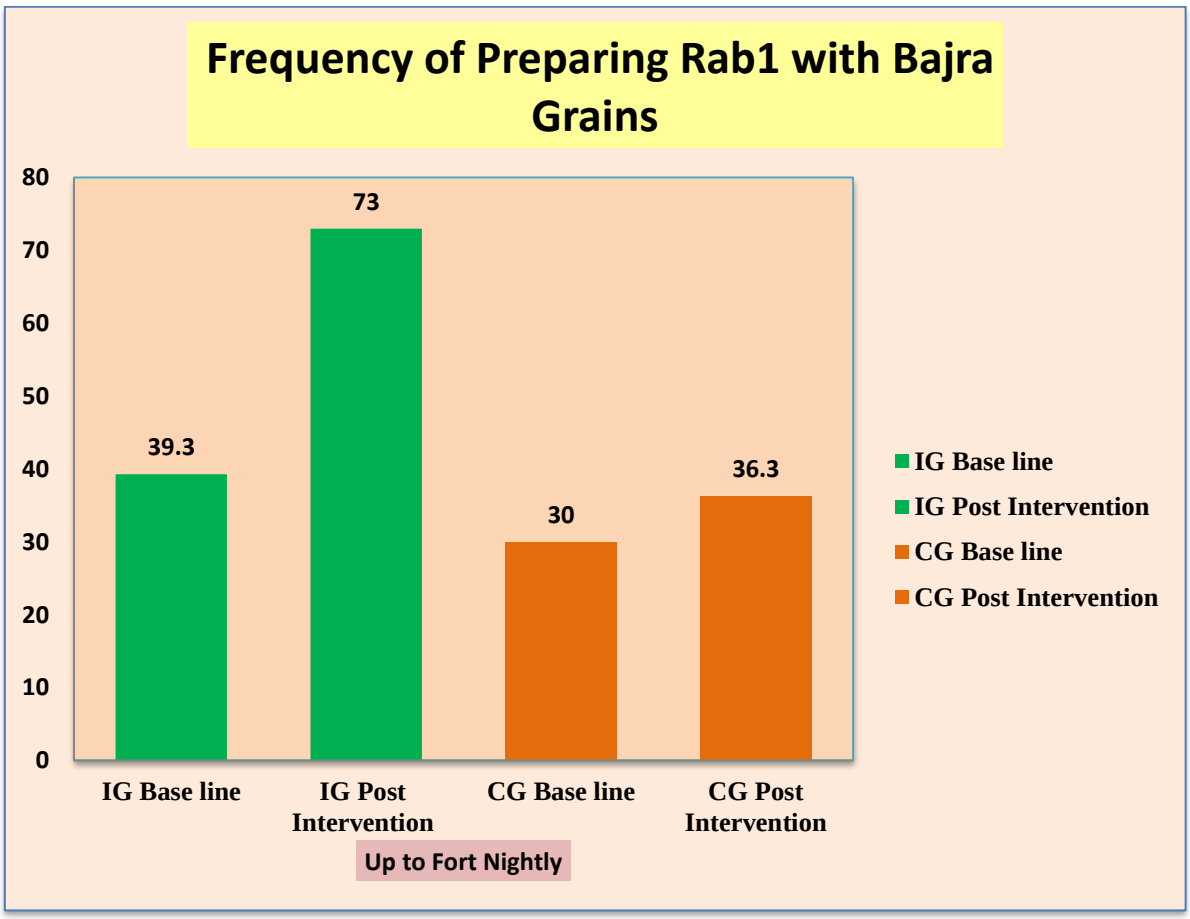



**Fig. 2**

**Table13: Frequency of preparing *Rab* with bajra flour (*Rab* 2) in Intervention Group**

| | Base Line | | | Mid Term | | Post Intervention | | |
|---|---|---|---|---|---|---|---|---|
| **Frequency of *Rab*** | **No. of RW** | **Percent (%)** | | **No. of RW** | **Percent (%)** | **No. of RW** | **Percent (%)** | |
| Daily | 21 | 5.2 | **72.6** | 29 | 7.5 | 28 | 8.2 | **69.2** |
| 2-3 timesa week | 109 | 26. 8 | | 98 | 25.2 | 83 | 24.3 | |
| Once a week | 117 | 28.8 | | 76 | 19.5 | 78 | 22.9 | |
| Fort Nightly | 48 | 11.8 | | 52 | 13.4 | 47 | 13.8 | |
| Seasonal | 18 | 4.4 | | 7 | 1.8 | 11 | 3.2 | |
| Rarely | 25 | 6.1 | | 20 | 5.1 | 24 | 7.0 | |
| Never | 69 | 16.9 | | 107 | 27.5 | 70 | 20.5 | |
| **Total** | **407** | **100** | | **389** | **100** | **341** | **100** | |

The result is not significant at p <0.05

**Table 14: Frequency of preparing *Rab* with bajra flour (*Rab* 2) in Control Group**

| | Control Group (Base Line) | | | Control Group (Final) | | |
|---|---|---|---|---|---|---|
| **Frequency of *Rab2*** | **No. of HH** | **Percent (%)** | | **No. Of HH** | **Percent (%)** | |
| Daily | 3 | 0.7 | | 10 | 3.0 | |
| 2-3 timesa week | 72 | 17.8 | | 40 | 12.1 | |
| Once a week | 69 | 17.0 | | 84 | 25.5 | |
| Fort Nightly | 49 | 12.1 | **47.6** | 67 | 20.3 | **60.9** |
| Seasonal | 76 | 18.8 | | 15 | 4.5 | |
| Rarely | 46 | 11.4 | | 24 | 7.3 | |
| Never | 90 | 22.2 | | 90 | 27.3 | |
| **Total** | **405** | **100** | | **330** | **100** | |

The result is significant at p <0.05

**Table15: Frequency of preparing *Kadhi* with bajra in Intervention Group**

| | Base Line | | | Mid Term | | Post Intervention | | |
|---|---|---|---|---|---|---|---|---|
| **Frequency of *Kadhi*** | **No. of RW** | **Percent (%)** | | **No. of RW** | **Percent (%)** | **No. of RW** | **Percent (%)** | |
| Daily | 2 | 0.5 | | 1 | 0.3 | 0 | 0 | |
| 2-3 timesa week | 103 | 25.3 | **81.6** | 197 | 50.6 | 188 | 55.1 | **91.2** |
| Once a week | 229 | 56.3 | | 158 | 40.6 | 123 | 36.1 | |
| Fort Nightly | 34 | 8.4 | | 20 | 5.1 | 20 | 5.9 | |
| Seasonal | 0 | 0 | | 0 | 0 | 0 | 0 | |
| Rarely | 1 | 0.2 | | 3 | 0.8 | 2 | 0.6 | |
| Never | 38 | 9.3 | | 10 | 2.6 | 8 | 2.3 | |
| **Total** | **407** | **100** | | **389** | **100** | **341** | **100** | |

The result is significant at p <0.05

**Table16: Frequency of preparing *Kadhi* with bajra in Control Group**

| | Control Group (Base Line) | | | Control Group (Final) | | |
|---|---|---|---|---|---|---|
| **Frequency of *Kadhi*** | **No. Of HH** | **Percent (%)** | | **No. Of HH** | **Percent (%)** | |
| Daily | 1 | 0.2 | | 2 | 0.6 | |
| 2-3 timesa week | 119 | 29.4 | | 73 | 22.1 | |
| Once a week | 121 | 29.9 | **59.3** | 115 | 34.8 | **56.9** |
| Fort Nightly | 58 | 14.3 | | 43 | 13.1 | |
| Seasonal | 15 | 3.7 | | 1 | 0.3 | |
| Rarely | 15 | 3.7 | | 13 | 3.9 | |
| Never | 76 | 18.8 | | 83 | 25.2 | |
| **Total** | **405** | **100** | | **330** | **100** | |

The result is significant at p <0.05

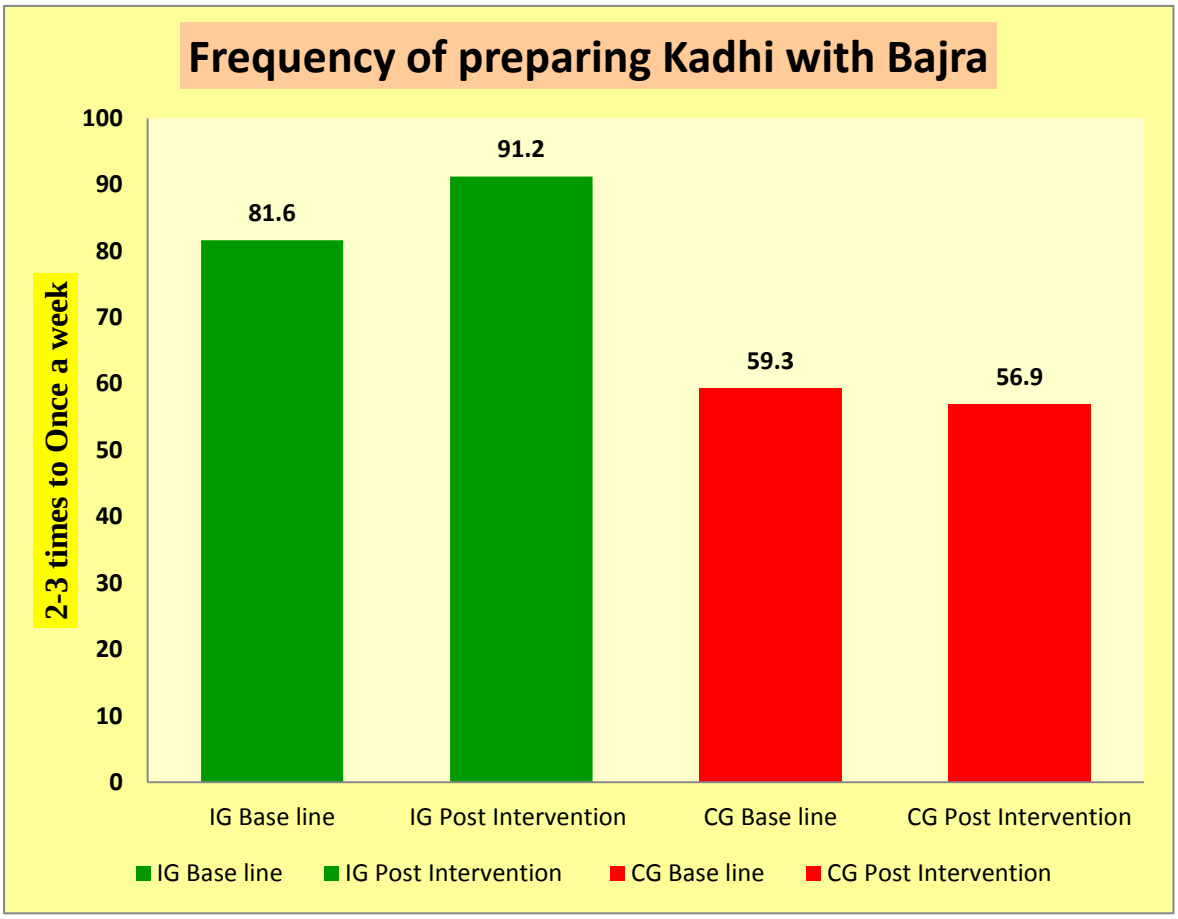



**Fig. 3**

**Table17: Frequency of preparing *Sogra* with bajra flour in Intervention Group**

| | Base Line | | Mid Term | | Post Intervention | |
|---|---|---|---|---|---|---|
| **Frequency of *Sogra*** | **No. of RW** | **Percent (%)** | **No. of RW** | **Percent (%)** | **No. of RW** | **Percent (%)** |
| Daily | 354 | **87.0** | 385 | 99.0 | 334 | **97.9** |
| 2-3 timesa week | 41 | 10.2 | 2 | 0.5 | 3 | 0.9 |
| Once a week | 6 | 1.5 | 0 | 0 | 1 | 0.3 |
| Fort Nightly | 1 | 0.2 | 0 | 0 | 1 | 0.3 |
| Seasonal | 3 | 0.7 | 2 | 0.5 | 2 | 0.6 |
| Rarely | 1 | 0.2 | 0 | 0 | 0 | 0 |
| Never | 1 | 0.2 | 0 | 0 | 0 | 0 |
| **Total** | **407** | **100** | **389** | **100** | **341** | **100** |

**Table18: Frequency of preparing *Sogra* with bajra flour in Control Group**

| | Control Group (Base Line) | | Control Group (Final) | |
|---|---|---|---|---|
| **Frequency of *Sogra*** | **No. Of HH** | **Percent (%)** | **No. Of HH** | **Percent (%)** |
| Daily | 280 | 69.1 | 289 | 87.6 |
| 2-3 timesa week | 50 | 12.4 | 19 | 5.8 |
| Once a week | 18 | 4.4 | 12 | 3.6 |
| Fort Nightly | 8 | 2.0 | 0 | 0 |
| Seasonal | 44 | 10.9 | 7 | 2.1 |
| Rarely | 2 | 0.5 | 1 | 0.3 |
| Never | 3 | 0.7 | 2 | 0.6 |
| **Total** | **405** | **100** | **330** | **100** |

The result is not significant at p <0.05

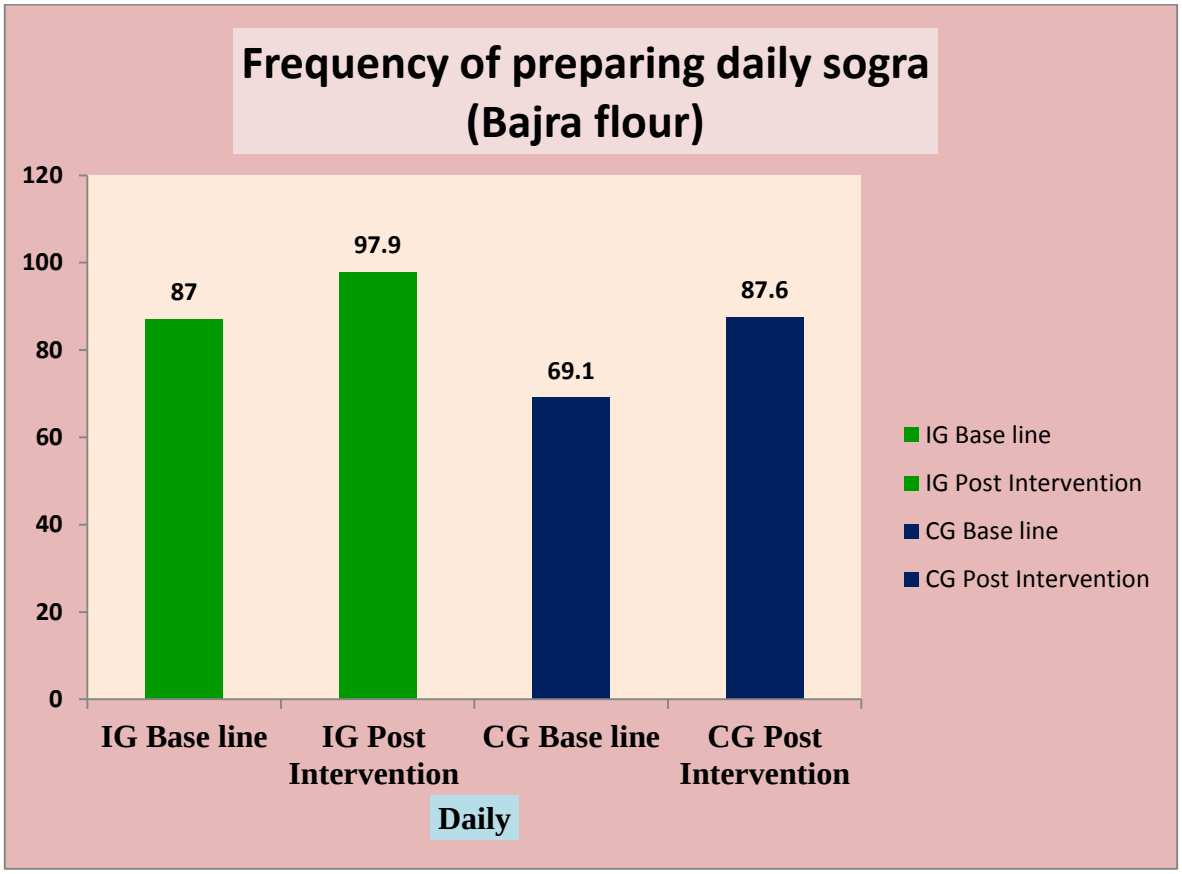



**Fig. 4**

The comparison of results of Baseline survey with Post Intervention survey regarding the method used for preparing Rab showed good significant incline in using method 'Soak, pound and Dehusk' from 20.9 to 54.0 percent (P <0.05), whereas, method 'Grind to flour' decreased from 70.5 to 42.8 percent in IG which received intervention. Whereas in CG,method used for preparing Rab showed negligible changes in using method 'Soak, pound and Dehusk' i.e. from 22.2 to 21.5 percent, whereas, method 'Grind to flour' slightly decreased from 65.2 to 60.3 percent (Tables 19-20 & Fig. 5).

The barrier for not using the 'Soak, pound and Dehusk' method was mainly reported to be labour, which declined 98.3 to 49.6 percent in IG after intervention, whereas, in CG also declined from 96.7 to 64.2 percent. Other reasons viz. tradition (0.7% in IG & 5.9 to 3% in CG) and taste reported were almost negligible (0.4 to 0.6% in IG & 0.4 to 0.3% in CG).

**Table19: Method used for preparing *Rab* in Intervention Group**

| | Base Line | | Mid Term | | Post Intervention | |
|---|---|---|---|---|---|---|
| **Method of preparing Rab** | **No. of RW** | **Percent (%)** | **No. of RW** | **Percent (%)** | **No. of RW** | **Percent (%)** |
| Pound, winnow and mill | 2 | 0.5 | 0 | 0 | 2 | 0.6 |
| Soak, pound, dehusk | 85 | **20.9** | 204 | 52.4 | 184 | **54.0** |
| Grind to flour | 287 | 70.5 | 175 | 45.0 | 146 | 42.8 |
| NA | 33 | 8.1 | 10 | 2.6 | 9 | 2.6 |
| **Total** | **407** | **100** | **389** | **100** | **341** | **100** |

The result is significant at $p < 0.05$

**Table 20: Method used for preparing *Rab* in Control Group**

| | Control Group (Base Line) | | Control Group (Final) | |
|---|---|---|---|---|
| **Method of preparing Rab** | **No. Of HH** | **Percent (%)** | **No. Of HH** | **Percent (%)** |
| Pound, winnow and mill | 8 | 2.0 | 0 | 0 |
| Soak, pound, dehusk | 90 | **22.2** | 71 | **21.5** |
| Grind to flour | 264 | 65.2 | 199 | 60.3 |
| NA | 43 | 10.6 | 60 | 18.2 |
| **Total** | **405** | **100** | **330** | **100** |

Not significant at $p > 0.05$

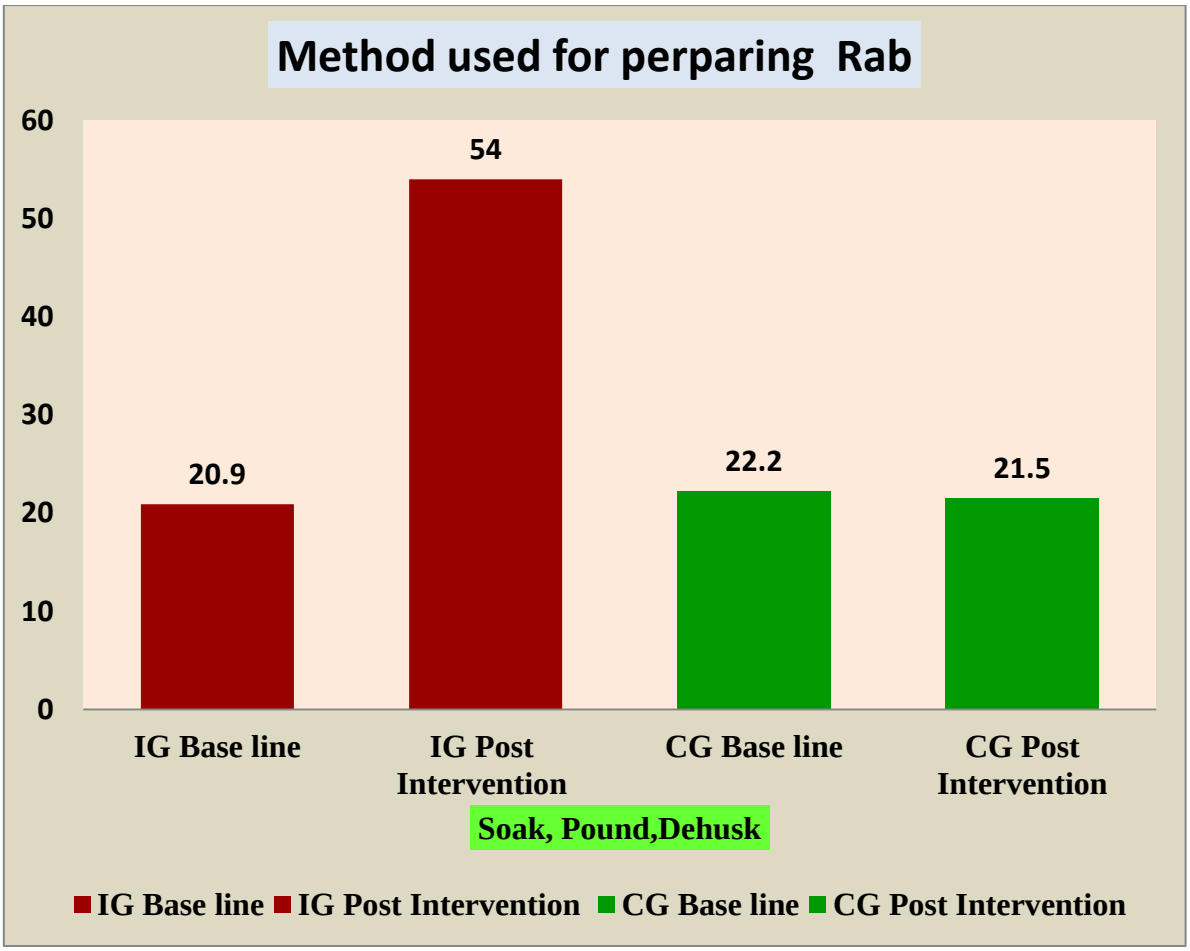



**Fig.5**

The comparison of results of Baseline survey with Post Intervention survey regarding the Flour used for preparing Kadhi showed good significant incline in using Pearl Millet Flour from 66.1 to 71.9 percent, whereas, use of Besan decreased from 9.1 to 3.2 in IG (P<.05). In CG, the Flour used for preparing Kadhi showed decline in using Pearl Millet Flour from 41.5 to 16.4 percent, whereas, use of Besan increased from 18.8 to 42.4 percent (Tables 21-22). Analysis regarding Type of tawa used for preparing sogra revealed that good percentage of women were using Iron Tawa i.e. 92. 4 percent in IG whereas 91.2 percent in CG. Mud Tawa was used by 7.6 and 8.8 percent in IG and CG groups respectively.

**Table 21: Flour used for preparing *Kadhi*n Intervention Group**

| | Base Line | | Mid Term | | Post Intervention | |
|---|---|---|---|---|---|---|
| **Flour used for kadhi** | **No. of RW** | **Percent (%)** | **No. of RW** | **Percent (%)** | **No. of RW** | **Percent (%)** |
| PM flour | 269 | **66.1** | 283 | 72.7 | 245 | **71.9** |
| Besan | 37 | 9.1 | 10 | 2.6 | 11 | 3.2 |
| Wheat Flour | 1 | 0.2 | 0 | 0 | 0 | 0 |
| PM +Besan | 100 | 24.6 | 96 | 24.7 | 85 | 24.9 |
| **Total** | **407** | **100** | **389** | **100** | **341** | 100 |

The result is significant at p <0.05 PM: Pearl Millet

**Table 22: Flour used for preparing *Kadhi* in Control Group**

| | Control Group (Base Line) | | Control Group (Final) | |
|---|---|---|---|---|
| **Flour used for kadhi** | **No. Of HH** | **Percent (%)** | **No. Of HH** | **Percent (%)** |
| PM flour | 168 | **41.5** | 54 | **16.4** |
| Besan | 76 | 18.8 | 140 | 42.4 |
| Wheat Flour | 0 | 0 | 0 | 0 |
| PM +Besan | 161 | 39.7 | 136 | 41.2 |
| **Total** | **405** | **100** | **330** | **100** |

The result is not significant at p <0.05

The comparison of results of Baseline survey with Post Intervention survey regarding knowledge about the beneficial effects of PM products showed good incline in their knowledge in case of Rab 1 (upto 89.4%), Kadhi (upto 53.1%) and Sogra (up to 73%) in IG whereas in CG almost negligible knowledge about the beneficial effects of PM products in Rab1, Kadhi and Sogra (1.8 to 7.9 %) (Tables 23-24).

**Table 23: Knowledge about the beneficial effects of PM products in Intervention Group**

| Beneficial effects of PM products on health | No. of HH (Base Line) N= 407 | | | | No. of HH (Mid Term) N= 389 | | | | No. of HH (Post Intervention) N= 341 | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Yes | (%) | No | (%) | Yes | (%) | No | (%) | Yes | (%) | No | (%) |
| Rab1 | 0 | 0 | 407 | 100.0 | 330 | 84.8 | 59 | 15.2 | 305 | 89.4 | 36 | 10.6 |
| Kadhi | 0 | 0 | 407 | 100.0 | 198 | 50.9 | 191 | 49.1 | 181 | 53.1 | 160 | 46.9 |
| Sogra | 0 | 0 | 407 | 100.0 | 302 | 77.6 | 87 | 22.4 | 249 | 73.0 | 92 | 27.0 |

The result is not significant at $p < 0.05$

**Table 24: Knowledge about the beneficial effects of PM products in Control Group**

| Beneficial effects of PM products on health | Control Group- No. of HH (Base Line) N= 405 | | | | Control Group- No. of HH (Final) N= 330 | | | |
|---|---|---|---|---|---|---|---|---|
| | Yes | Percent (%) | No | Percent (%) | Yes | Percent (%) | No | Percent (%) |
| Rab1 | 0 | 0 | 405 | 100 | 26 | 7.9 | 304 | 92.1 |
| Kadhi | 0 | 0 | 405 | 100 | 6 | 1.8 | 324 | 98.2 |
| Sogra | 0 | 0 | 405 | 100 | 15 | 4.5 | 315 | 95.5 |

The comparison of results of Baseline survey with Post Intervention survey regarding Dietary intake (24 hour recall method) revealed that Mean energy intake was 1627.7 and 1748.3 Kcal/day at baseline and after intervention in control group which was lower with respect to RDA, ICMR i.e. 2230 Kcal, whereas, in intervention group, Mean energy intake was 2037.3 and 1676.1Kcal/day at baseline and after intervention, lower with respect to RDA, ICMR. There is negligible difference in all nutrients viz. Protein, Fibers, Calcium, Iron, Zinc and other nutrients in CG and IG before and after intervention.

The knowledge regarding the value of Iron and Zinc retention in Rab 1 prepared from pearl millet grains and Sogra prepared on Iron Tawa and Kadhi was negligible in the baseline survey. Their knowledge was found to be increased from nil to 98.5 percent regarding the higher retention of Iron in Sogra if prepared on Iron Tawa in IG, whereas, in CG it raises from 1.5 to 63.3 percent.

The comparison of results of Baseline survey, Mid with Post Intervention survey regarding knowledge about anemia and Zn Deficiency showed incline in case of anemia (50.9 to 69.2%) and almost negligible in case of Zn deficiency (0.5 to 0.6%) in IG, whereas, in CG, knowledge was negligible (0.9 to 1.2%). Regarding the Knowledge about the cause of anemia, the comparison showed a good incline in knowledge i.e. due to deficiency of Iron, (80.5 to 85%) in IG, whereas, in CG only 1.5 percent knew about it. Regarding the sources of Iron in diet, their knowledge regarding the use of pearl Millet (PM) Soak, Pound and Dehusk, increased upto 88.6 to 90 percent and use of GLV in diet increased up to 39.6 to 47.2 percent in IG, whereas, in CG, increased only up to 2.1 and 1.8 percent respectively (Tables 25-30).

The comparison of results of Baseline survey, Mid with Post Intervention survey regarding their knowledge about the effect of processing of PM on prevention of anemia, in IG, knowledge increased significantly from nil to 92 percent (mid survey) and 94.4 percent (Post intervention survey), whereas, in CG only 1.5 percent knew about this (Tables 31 & 32).

**Table 25: Knowledge about some MDDs in Intervention Group**

| Knowledge about some MDDs | No. of HH (Base Line) N= 407 | | | | No. of HH (Mid Term) N=389 | | | | No. of HH (post Intervention) N= 341 | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Yes | (%) | No | (%) | Yes | (%) | No | (%) | Yes | (%) | No | (%) |
| Anaemia | 0 | 0 | 407 | 100 | 198 | 50.9 | 191 | 49.1 | 236 | 69.2 | 105 | 30.8 |
| Zn deficiency | 0 | 0 | 407 | 100 | 2 | 0.5 | 387 | 99.5 | 2 | 0.6 | 339 | 99.4 |

**Table 26: Knowledge about some MDDs in Control Group**

| Knowledge about some MDDs | Control Group- No. of HH (base Line) N= 405 | | | | Control Group- No. of HH (Final) N= 330 | | | |
|---|---|---|---|---|---|---|---|---|
| | Yes | Percent (%) | No | Percent (%) | Yes | Percent (%) | No | Percent (%) |
| Anaemia | 5 | 1.2 | 400 | 98.8 | 3 | 0.9 | 327 | 99.1 |
| Zn deficiency | 0 | 0 | 405 | 100 | 0 | 0 | 330 | 100 |

**Table 27: Knowledge about the cause of anemia in Intervention Group**

| | Base Line | | Mid term | | Post Intervention | |
|---|---|---|---|---|---|---|
| **Cause of anemia** | **No. of HH** | **Percent (%)** | **No. of HH** | **Percent (%)** | **No. of HH** | **Percent (%)** |
| Deficiency of iron | 0 | 0 | 313 | 80.5 | 290 | 85.0 |
| Don't know | 407 | 100.0 | 76 | 19.5 | 51 | 15.0 |
| **Total** | **407** | **100** | **389** | 100 | **341** | 100 |

**Table 28: Knowledge about the cause of anemia in Control Group**

| | Control Group (Base Line) | | Control Group (Final) | |
|---|---|---|---|---|
| **Cause of anemia** | **No. of HH** | **Percent (%)** | **No. of HH** | **Percent (%)** |
| Deficiency of iron | 0 | 0 | 5 | 1.5 |
| Don't know | 405 | 100 | 325 | 98.5 |
| **Total** | **405** | **100** | **330** | 100 |

**Table 29: Knowledge about the sources of iron in diet in Intervention Group**

| **Sources of iron** | **No. of HH (Base Line) N= 407** | | | | **No. of HH (Mid term) N= 389** | | | | **No. of HH (Post Intervention) N= 341** | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **Yes** | **(%)** | **No** | **(%)** | **Yes** | **(%)** | **No** | **(%)** | **Yes** | **(%)** | **No** | **(%)** |
| PM Soak, pound dehusked | 0 | 0 | 407 | 100 | 350 | 90.0 | 39 | 10.0 | 302 | 88.6 | 39 | 11.4 |
| GLVs | 0 | 0 | 407 | 100 | 154 | 39.6 | 235 | 60.4 | 161 | 47.2 | 180 | 52.8 |

**Table 30: Knowledge about the sources of iron in diet in Control Group**

| Sources of iron | Control Group- No. of HH (Base Line) N= 405 | | | | Control Group- No. of HH (Final) N= 330 | | | |
|---|---|---|---|---|---|---|---|---|
| | Yes | Percent (%) | No | Percent (%) | Yes | Percent (%) | No | Percent (%) |
| PM Soak, pound, dehusked | 0 | 0 | 405 | 100 | 7 | 2.1 | 323 | 97.9 |
| GLVs | 2 | 0.49 | 403 | 99.51 | 6 | 1.8 | 324 | 98.2 |

**Table 31: Knowledge about the effect of processing of PM on prevention of anemia**

| | Base Line | | Mid term | | Post Intervention | |
|---|---|---|---|---|---|---|
| Can anemia be prevented by processing PM | No. of RW | Percent (%) | No. of RW | Percent (%) | No. of RW | Percent (%) |
| Yes | 0 | 0 | 358 | 92.0 | 322 | 94.4 |
| No | 407 | 100.0 | 31 | 8.0 | 19 | 5.6 |
| **Total** | **407** | **100** | **389** | 100 | **341** | 100 |

**Table 32: Knowledge about the effect of processing of PM on prevention of anemia**

| | Control Group (Base Line) | | Control Group (Final) | |
|---|---|---|---|---|
| Can anemia be prevented by processing PM | No. of HH | Percent (%) | No. of HH | Percent (%) |
| Yes | 1 | 0.2 | 5 | 1.5 |
| No | 404 | 99.8 | 325 | 98.5 |
| **Total** | **405** | **100** | **330** | **100** |

This result is not significant at $p < 0.05$

Estimation of Hb% before and after the intervention in both study and control groups so as to observe the improvement in anemia in women was taken as **secondary objective in** the study group. In intervention Group, Non response rate was 2.2 percent in pre intervention survey and 1.5 percent in post intervention survey. In Control group, Non response rate was 6.7 percent in pre intervention survey and 0.9 percent in post intervention survey (Tables 33 & 34).

The comparison of results of Baseline survey with Post Intervention survey revealed that severe anemia declined significantly from 59.3 to 38.1 percent, Moderate anemia declined from 38.7 to 26.2 percent and Normal (not anemic) increased significantly from 0.3 to 27.7 percent in IG, which received intervention for one year (P <.05). This showed good impact of intervention on reduction of anemia in IG. In CG, Mild anemia inclined from 4 to 12.2 percent, Moderate anemia inclined from 45.5 to 57.5 percent and Normal(not anemic) inclined from 0.5 to 4.9 percent only (Fig. 6).

**Table 33: Percent Coverage of blood samples taken in Intervention Group**

| | **Intervention group (Baseline)** | | **Intervention group (Post Intervention)** | |
|---|---|---|---|---|
| **Blood sample taken** | **No. of RW** | **Percent (%)** | **No. of RW** | **Percent (%)** |
| Yes | 398 | 97.8 | 336 | 98.5 |
| No | 9 | 2.2 | 5 | 1.5 |
| **Total** | **407** | **100** | **341** | 100 |

**Table 34: Percent Coverage of blood samples taken in Control Group**

| | **Control Group (Base Line)** | | **Control Group (Final)** | |
|---|---|---|---|---|
| **Blood sample taken** | **No. of RW** | **Percent (%)** | **No. of RW** | **Percent (%)** |
| Yes | 379 | 93.3 | 327 | 99.1 |
| No | 26 | 6.7 | 3 | 0.9 |
| **Total** | **405** | **100** | **330** | 100 |

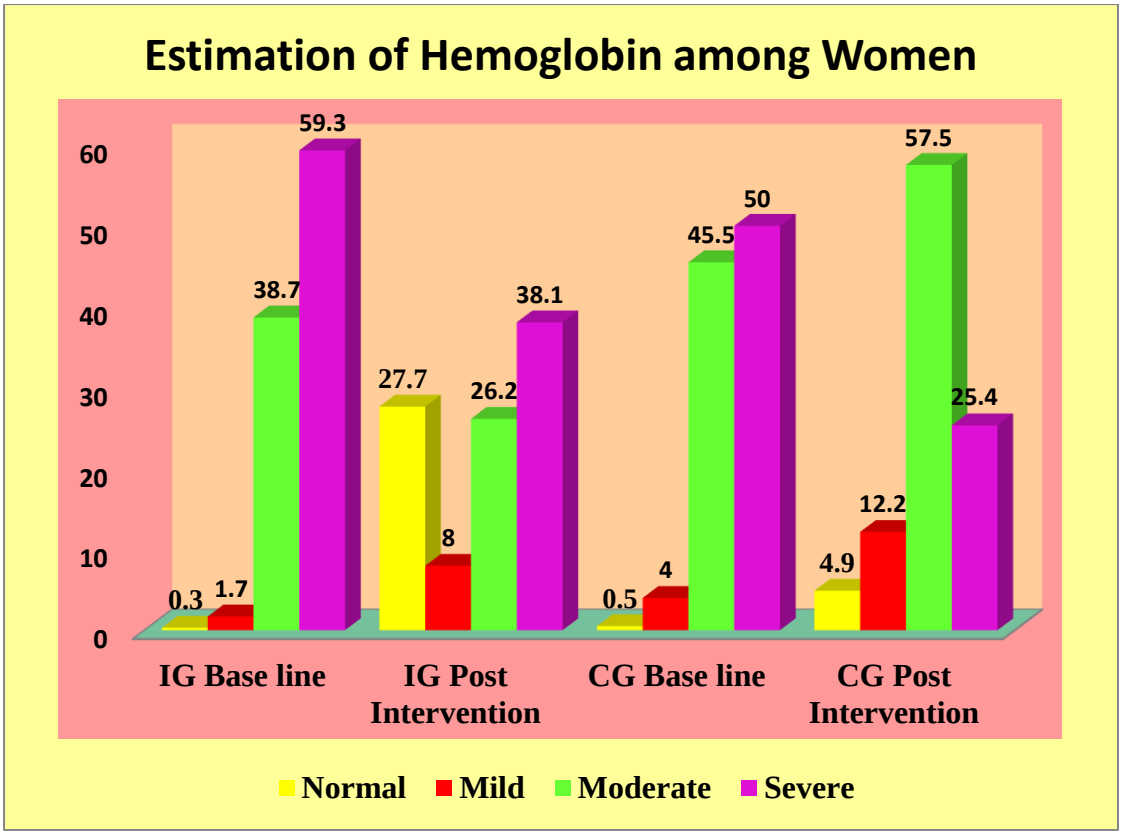



**Fig. 6**

**Table 35: Estimation of Hemoglobin among women in Intervention Group**

| | Intervention group (Pre Intervention) | | Intervention group (Post Intervention) | |
|---|---|---|---|---|
| **Classification of women on the basis of Hb values** | **No. of RW** | **Percent (%)** | **No. of RW** | **Percent (%)** |
| **Normal (12.0 gm/dl)** | 1 | 0.3 | 93 | 27.7 |
| **Mild (11-11.9 gm/dl)** | 7 | 1.7 | 27 | 8.0 |
| **Moderate (8.1-10.9 gm/dl)** | 154 | 38.7 | 88 | 26.2 |
| **Severe (<=8.0gm/dl)** | 236 | 59.3 | 128 | 38.1 |
| **Total** | **398** | **100** | **336** | 100 |

The result is significant at p <0.05

**Table 36: Estimation of Hemoglobin among women in Control Group**

| | Control Group (Base Line) | | Control Group (Final) | |
|---|---|---|---|---|
| **Classification of women on the basis of Hb values** | **No. of RW** | **Percent (%)** | **No. of RW** | **Percent (%)** |
| **Normal (12.0 gm/dl)** | 2 | 0.5 | 16 | 4.9 |
| **Mild (11-11.9 gm/dl)** | 15 | 4.0 | 40 | 12.2 |
| **Moderate (8.1-10.9 gm/dl)** | 172 | 45.5 | 188 | 57.5 |
| **Severe (<=8.0 gm/dl)** | 189 | 50.0 | 83 | 25.4 |
| **Total** | **378** | **100** | **327** | 100 |

The result is significant at $p < 0.05$

## 11. Conclusions summarizing the achievements and indication of scope for future work.

**Summary**

Pearl millet is a significant source of dietary energy and nutritional security for poor farmers and consumers in desert areas of Rajasthan in India. Very few studies, based on local dietary approach have been attempted for the reduction of micronutrient deficiencies, particularly Iron and Zinc. Pearl Millet is the staple diet of this area. The present project on 'Development of IEC modules for the promotion of three local pearl millet preparations viz. Rab1 (Pearl millet Grains), Kadhi and Sogra, which will help in improvement of dietary intake of Iron which, in turn, will help in reduction of anemia among rural population of Nagaur district of Rajasthan has been carried out, based on the findings of earlier completed project on Pearl Millet, and will facilitate NACP program. The primary objectives of the study were 'Development of IEC modules for promotion of three local pearl millet preparations viz. Rab1 (Pearl millet Grains), Kadhi and Sogra to improve the knowledge of the rural population w.r.t. to pearl millet consumption'; 'Development of a range of educational materials highlighting health, nutrition & therapeutic values of different pearl millet preparation for improvement of dietary intake of Iron of the rural population'; 'Improvement in the food practices of the rural population w.r.t. to local pearl millet preparations and to study the barriers, if any, related to it; 'Assessment of IEC module developed for the promotion of three local pearl millet preparations with increase in their consumption pattern in their diet, as an outcome indicator, whereas, the secondary objective was 'estimation of Hb% before and after the intervention in both study and control groups so as to observe the improvement in anemia in women in the study group'. This is an intervention study carried out in Nagaur, a desert district of Rajasthan. Cluster Randomized trial was adopted for this study. From the selected two tehsils, six villages were selected i.e. three villages in each tehsil on the basis of simple random sampling technique for effective intervention. Three villages were selected from Kheenvsar tehsil i.e. Dharnawas, Bhavanda and Akla, taken as intervention group to whom intensive intervention was given for one year. Three villages were selected initially in Merta tehsil taken as control group but required sample size was not completed in three villages so two more villages, adjacent to selected villages, were covered to achieve the required sample size. These five villages were Sodas, Basni Siyacharnan, Dhadhasani, Shekhasani and Mangaliyawas in control group to whom general advice was given at the time of survey. From each village, all the households, which have women in the child bearing age (15-45 years), were selected using a complete list of all households in each village.

Baseline survey was completed and a total of 812 households (407 Intervention group & 405 Control group) were registered for the study. All the subjects were interviewed for collection of Socio-Demographic profile, Use of pearl millet products in their dietary habit, Information regarding their knowledge w.r.t. preparations of different type of recipes from pearl millet which have more Iron and Zinc, and their method of preparation, Consumption pattern of different local Pearl millet preparations in their diet and Hemoglobin estimation using Cyanmethaemoglobin technique and classified according to WHO classification.

In control group, only general advice regarding the dietary modification stressing the role of enhancers and inhibitors in diet, useful preparations of pearl millet, etc. was given at the time of survey.

After baseline survey, educational printed material was developed, in local language, in the form of pamphlets, flip charts and pictorials. In Intervention group, before baseline survey, 1st training, and 2nd training, after baseline survey, was conducted at Khinvsar Block Center where Lady supervisor of Khinvsar and all the ASHA/ AW workers of Khinvsar tehsil were present and knowledge was imparted as per study protocol.

In Intervention group, **Nutritional councilling i.e. IEC** was provided to all the Aganwari / ASHA workers, during monthly block meeting of the Lady Supervisors with AWs twice, first in the beginning of the study and then after the completion of the baseline survey, regarding dietary intake:-

- Therapeutic values of different pearl millet preparations for promotion of three local pearl millet preparations viz. Rab1 (Pearl millet Grains), Kadhi and Sogra to improve the knowledge of the rural population w.r.t. to pearl millet consumption which in turn will help in reduction of anemia.
- Knowledge regarding the preparations of different type of preparations / recipes from pearl millet viz. Rab1 (Pearl millet Grains), Kadhi and Sogra which have more retention of iron and zinc after cooking.
- IEC was provided regarding promotion of consumption of those preparations of pearl millet which have more retention of iron and zinc after cooking.
- In addition to the above knowledge regarding pearl millet, IEC was also provided to disseminate available scientific knowledge to the community for reduction of micronutrient deficiencies such as anemia/Zinc by means of dietary modification.

All the trained Aganwari / ASHA workers of the selected villages along with research team were requested for further dissemination of the knowledge to their respected areas of the selected villages under the supervision of research team.

**IEC was imparted by adopting the following three approaches monthly i.e. 1. Household level approach; 2. Group approach, and 3. Mass approach.** In addition to this, **quarterly meetings** of research team with CDPO, Aganwari workers / ASHA workers / Sahyogini, etc. along with 10 main key persons from village i.e. Panch, Sarpanch, Ward Panch, teacher, etc., were conducted for group discussion regarding the above mentioned information of pearl millet so as to do the effective dissemination of the knowledge at community level.

**Training of Aganwari / ASHA Workers:** Training was provided to all the AWs / ASHA workers twice, first in the beginning of the study and secondly after the completion of the baseline survey (two days in each training). Educational material (printed in local language) was also distributed in the form of pamphlets and pictorials. Hands on training was given to them so that they can further impart this knowledge to all the women registered for the study.

Intervention was continued for one year with Mid term survey only in IG. After one year, all the registered women were examined again for all the parameters as done in the beginning of the study, in both the groups i.e. control and intervention groups and thereafter comparison was made to observe the impact of IEC module developed for the promotion of three local pearl millet preparations viz. Rab1 (Pearl millet Grains), Kadhi and Sogra, with increase in the consumption pattern in their diet in terms of their frequency observations as an outcome indicator along with enhancement, in terms of percentage, in their knowledge regarding the therapeutic values/

beneficial effect of different pearl millet preparations, their usage in their dietary habit along with the methods of cooking for the promotion of three local pearl millet preparations viz. Rab1 (Pearl millet Grains), Kadhi and Sogra, which may help in improvement of dietary intake of Iron of the rural population which, in turn, help in reduction of anemia among rural population of study area. Estimation of Hb% before and after the intervention in both study and control groups, as a secondary objective, was also done so as to observe the improvement in anemia in womenin the study group.

**Important Findings**

Socio-demographic distribution of registered women (HHs) in Control and Intervention Groups showed that 94.6 to 96.8 percent were Hindus and 20.7 to 26.0 percent belong to Scheduled caste community. Illiteracy was high (63.7 to 72.7%) and 73.8 to 78.8 percent belong to HW category, whereas, 15.8 to 23.8 percent were involved in Labourer occupation.

On the basis of the observations made during Baseline survey and Post Intervention survey in both IG and CG, the following important findings were emerged:

- Frequency of preparation of Rab 1 from pearl millet grains, up to fort nightly, in IG, increased significantly ($P<0.05$) from 39.3 to 73.0 percent indicating good impact of intervention, which is **an outcome indicator** in this study, whereas, in CG, slight incline from 30 to 36.3 percent was observed.

- Frequency of preparation of Rab 2 from pearl millet flour, up to fortnightly, in IG, observed decrease from 72.6 to 69.2 percent indicating good impact of intervention, whereas, in CG, inclined from 47.6 to 60.9 percent.

- Frequency of preparing Kadhi with Bajara flour in IG increased significantly from 81.6 to 91.2 percent ($P <0.05$), whereas, in Control Group, declined from 59.3 to 56.9 percent.

- The comparison of frequency of preparation of Sogra prepared daily increased from 87.0 to 97.9 percent and decreased 2-3 times a week from 10.2 to 0.9 percent and once a week from 1.5 to 0.3 percent in IG, which received intervention revealing good impact of intervention. In CG, frequency of preparation of Sogra prepared daily increased from 69.1 to 87.6 percent and decreased 2-3 times a week from 12.4 to 5.8 percent and once a week from 4.4 to 3.6 percent.

- This showed a good impact of intervention in IG in promotion of three pearl millet preparations i.e. Rab 1 (Bajra grains), Sogra and Kadhi which were taken as **outcome indicator.**

- The comparison of results of Baseline survey with Post Intervention survey regarding the method used for preparing Rab showed good significant incline in using method 'Soak, pound and Dehusk' from 20.9 to 54.0 percent ($P <0.05$), whereas, method 'Grind to flour' decreased from 70.5 to 42.8 percent in IG which received intervention. Whereas, in CG, method used for preparing Rab showed negligible changes in using method 'Soak, pound

and Dehusk' i.e. from 22.2 to 21.5 percent, whereas, method 'Grind to flour' slightly decreased from 65.2 to 60.3 percent.

- The barrier for not using the 'Soak, Pound and Dehusk' method was mainly reported to be labour intensive which declined 98.3 to 49.6 percent in IG after intervention, which also declined from 96.7 to 64.2 percent in CG. Other reasons viz. tradition (0.7% in IG & 5.9 to 3% in CG) and taste reported were found almost negligible (0.4 to 0.6% in IG & 0.4 to 0.3% in CG).

- The impact of intervention on the Flour used for preparing Kadhi showed good incline in using Pearl Millet Flour from 66.1 to 71.9 percent, whereas, use of Besan decreased from 9.1 to 3.2 in IG. In CG, the Flour used for preparing Kadhi showed decline in using Pearl Millet Flour from 41.5 to 16.4 percent, whereas, use of Besan increased from 18.8 to 42.4 percent. Analysis regarding Type of tawa used for preparing sogra revealed that good percentage of women were using Iron Tawa i.e. 92. 4 percent in IG whereas 91.2 percent in CG. Mud Tawa used by 7.6 and 8.8 percent in IG and CG respectively.

- The impact of intervention regarding knowledge about the beneficial effects of Pearl Millet products showed good incline in their knowledge from negligible to 89.4 percent, in case of Rab 1, up to 53.1 percent in case of Kadhi and Sogra (up to 73%) in IG, whereas, in CG almost knowledge was negligible about the beneficial effects of PM products in Rab1, Kadhi and Sogra (1.8 to 7.9 %).

- The knowledge regarding the value of Iron and Zinc retention in Rab 1 prepared from pearl millet grains and Sogra prepared on Iron Tawa and Kadhi was negligible in the baseline survey. Their knowledge has increased from nil to 98.5 percent regarding the higher retention of Iron in Sogra if prepared on iron Tawa in IG, whereas, in CG it raises from 1.5 to 63.3 percent.

- The comparison of results of Baseline survey, with the Post Intervention survey regarding knowledge about anemia and Zn Deficiency showed incline in case of anemia (negligible to 50.9 to 69.2%) and almost negligible in case of Zn deficiency (0.5 to 0.6%) in IG ,whereas, in CG, knowledge was negligible (0.9 to 1.2%). Regarding the Knowledge about the cause of anemia, the comparison showed a good incline in knowledge i.e. due to deficiency of Iron, (negligible to 80.5 to 85%) in IG, whereas, in CG only 1.5 percent knew about it. Regarding the sources of Iron in diet, their knowledge regarding the use of Pearl Millet (PM) Soak, Pound and Dehusk, increased up to 88.6 to 90 percent and use of GLV in diet increased up to 39.6 to 47.2 percent in IG, whereas, in CG, increased only up to 2.1 and 1.8 percent respectively.

- The comparison of results of Baseline survey, with the Post Intervention survey regarding their knowledge about the effect of processing of PM on prevention of anemia, in IG, knowledge increased significantly from nil to 94.4 percent (Post intervention survey), whereas, in CG only 1.5 percent knew about this.

Estimation of Hb% before and after the intervention in both study and control groups so as to observe the improvement in anemia in women was taken as s**econdary objective in** the study group.

- The comparison of results of Baseline survey with the Post Intervention survey revealed that severe anemia declined significantly from 59.3 to 38.1 percent, Moderate anemia declined from 38.7 to 26.2 percent and Normal (non anemic) increased significantly from 0.3 to 27.7

percent in IG which received intervention for one year (P <0.05). This showed good impact of intervention on reduction of anemia in IG. In CG, Mild anemia inclined from 4 to 12.2 percent, Moderate anemia inclined from 45.5 to 57.5 percent and Normal (non anemic) inclined from 0.5 to 4.9 percent only.

**Recommendations for Future actions**

- IEC module showed significant impact on promotion of local preparations of Pearl Millet, first Rab1 (Pearl millet grain), where process of Soaking, Pounding & De-husking process involved in cooking, and then Kadhi and Sogra.
- Anemia declined up to 27.4% in Intervention Group, whereas, in Control Group remained almost same.
- A state level program for inclusion of Pearl millet preparations in Mid Day Meal Program for school Children & ICDS Program, involving Ministry of Women & Child Development & Human Resource Development' may be launched in Rajasthan in Collaboration with State Health Department, GOR.
- Food Based approach to reduce MDDs especially anemia, based on the findings of this project, on local staple food preparations (Pearl Millet), may be aggressively perused.
- Community based Nutrition Intervention models using Local food preparations of Pearl Millet with State Govt. to strengthen existing programs of Govt. by Partnership Research Programs may be pursued.

**12. S&T benefits accrued:**

**I. List of research publications with complete details:** **02 papers presented in Rajasthan Conclave IV**
Authors, Title of paper, Name of Journal, Vol., page, year

- Madhu B. Singh., Robin Marwal., Richa Pant., Manmohan Singh., Vinod Kumar., Satvir S.Tevatiya., Purnima Pathak., Ankit Parihar & Neetu Parihar. A study on dietary intake patterns among woman of reproductive age group in Nagaur district of Rajasthan. Abstracted in Proceedings of *'Rajasthan Conclave IV'* organized by Desert Medicine Research Centre from 12th to 14th November, 2016, pp79 at DMRC, Jodhpur
- Madhu B. Singh., Richa Pant., Robin Marwal., Manmohan Singh., Vinod Kumar., Satvir S.Tevatiya., Purnima Pathak., Ankit Parihar & Neetu Parihar. Chronic Energy Deficiency among woman of child bearing age (15-45 years) in Nagaur district of Rajasthan and Its association with Socio Economic parameters. Abstracted in Proceedings of *'Rajasthan Conclave IV'* organized by Desert Medicine Research Centre from 12th to 14th November, 2016, pp 50-51, at DMRC, Jodhpur

**II Manpower trained on the project:**

**a.** Research Scientists or Research Fellows/Assistants/Workers: **07**
**b.** No. of Ph.Ds produced: Nil
**c.** Other Technical Personnel trained/ICDS Supervisors/ AWs/ASHA etc: **157**
**d.** Persons in Field: **3360**

**III. Patents taken, if any:** Nil

**IV Products developed, if any:** **IEC**-Intervention material developed in Hindi - **Annexure I-III**

Intervention material (IEC) developed in Hindi for imparting the knowledge to rural population, adopting three intervention approaches, for promotion of three local pearl millet preparations *viz.* Rab1 (Pearl millet Grains), Kadhi and Sogra to improve their knowledge w.r.t. to pearl millet consumption, regarding the preparations of different type of preparations / recipes of pearl millet which have more retention of Iron and Zinc after cooking which in turn will help in reduction of anemia:-

1. Flip chart booklet- Annexure I
2. Pamphlets- Annexure II
3. Poster pictorials- Annexure III

**13. Abstract (300 words for possible publication in ICMR Bulletin).**


## Abstract:

The present study on 'Development of IEC modules for the promotion of three local pearl millet preparations viz. Rab1 (Pearl millet Grains), Kadhi and Sogra, which will help in improvement of dietary intake of Iron, and reduction of anemia among rural population of Nagaur district of Rajasthan, is an outcome of the findings of my earlier project on Pearl Millet.

**Study design:** Intervention study

**Sample size:** The Study was carried out in Nagaur, a desert district of Rajasthan adopting Cluster Randomized trial in two tehsils i.e. Khinvsar for intervention and Merta for Control covering 812 households (407 IG & 405 CG).The Respondents of the study were women who were cooking food i.e. 15 years and above. The intervention was done for a period of one year adopting three approaches i.e. House hold level approach, Group approach and Mass approach, through education material developed in the form of Pamphlets, Poster pictorials & Flip chart booklets, involving local health & ICDS functionaries regarding promotion of three local Pearl Millet preparations viz. Rab1 (Pearl millet Grains), Kadhi and Sogra which have more retention of iron and zinc after cooking and help in reduction of anemia.

**Results:**

The study revealed that in IG, frequency of preparation of Rab 1 from pearl millet grains up, to fort nightly, increased significantly ($P<0.05$) from 39.3 to 73.0 percent indicating good impact of intervention, which is an outcome indicator in this study, whereas, in CG, slight incline from 30 to 36.3 percent was observed. In IG group, frequency of preparing Kadhi with Bajara flour increased significantly from 81.6 to 91.2 percent ($P<0.05$), whereas, in Control Group, declined from 59.3 to 56.9 percent. The comparison of frequency of preparation of Sogra prepared daily increased from 87 to 97.9 percent in IG. IEC module showed significant impact on promotion of Rab1 (Pearl millet grain), where process of Soaking, Pounding & De-husking process involved in cooking along with Kadhi and Sogra prepared from Pearl millet, which were taken as **outcome indicator**. Anemia declined up to 27.4% in Intervention Gr. whereas in Control Gr. remained almost same.

**Recommendation:** A state level program for inclusion of Pearl millet preparations in Mid Day Meal Program for school Children & ICDS Program, involving Ministry of Women & Child Development & Human Resource Development' may be launched in Rajasthan in Collaboration with State Health Department, GOR. Food Based approach to reduce MDDs especially anemia, based on the findings of this project, on local staple food preparations (Pearl Millet), may be aggressively perused. Community based Nutrition Intervention models using Local food preparations (Pearl Millet) with State Govt. to strengthen existing programs of Govt. by Partnership Research Programs may be pursued.

**14. Procurement/usage of Equipment:** No equipment purchased

**a.**

| S.No | Name of Equipment | Name of Make/M | Cost FE/Rs | Date of Installation | Utilisation rate % | Remarks regarding maintenance/breakdown |
|---|---|---|---|---|---|---|
| | | | | | | |

**b. Suggestions for disposal of equipment(s):** Not Applicable

**Name and signature with date**

**1. Dr. Madhu Bala Singh**
**(Principal Investigator)**

# Pearl Millet Project Team

| | | |
|---|---|---|
| 1. | Dr. NeetuParihar | Consultant -Nutrition |
| 2. | Dr. Richa Pant | Project Assistant |
| 3. | Dr. Robin Marwal | Project Assistant |
| 4. | Mr. Manmohan Singh | Project Assistant |
| 5. | Ms. Khushboo Vyas | Project Assistant |
| 6. | Ms. SakshiUjwal | Project Assistant |
| 7. | Mr. VikramSisodia | Project Technician |
| 8. | Mr. Ankit Parihar | Project Technician |
| 9. | Mr. Bharat Kumar Sen | Project Field Worker |
| 10. | Mr. Vinod Kumar | Project Field Worker |
| 11. | Mr. Satvir Singh Tevatiya | Project Field Worker |
| 12. | Ms. Purnima Pathak | Project Field Worker |

# Annexure I

# IEC Pearl Millet:  Flip Chart Booklet

# Annexure II

# IEC Pearl Millet: Pamphlets in Hindi

# Annexure III

# IEC Pearl Millet: Poster pictorials

# आयरन (IRON)

मरूस्थलीय आयुर्विज्ञान अनुसंधान केन्द्र
(भारतीय आयुर्विज्ञान अनुसंधान परिषद)
नई पाली रोड, जोधपुर – 342005

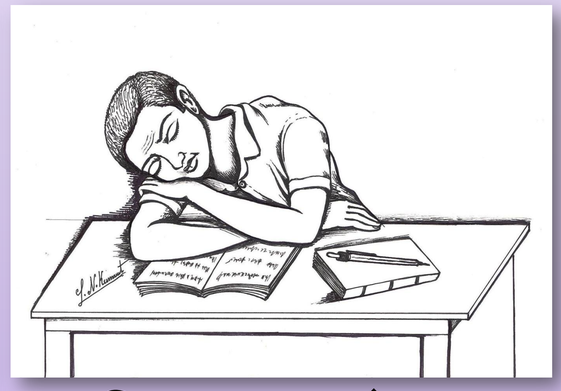
**आयरन (लौह तत्व) एक खनिज है जो खाद्य पदार्थों में पाया जाता है। रक्त में ऑक्सीजन के प्रवाह को बनाए रखने में आयरन की अत्यन्त महत्वपूर्ण भूमिका है। आयरन की कमी से एनीमिया होता है।**

## एनीमिया के लक्षण

शरीर का रंग पीला पड़ना

आँख के कोरों में लालिमा न होना

कोइलोनिशिया



अत्यधिक थकान व सांस फूलना

## प्रतिदिन खाने में आयरन की आवश्यक मात्रा (RDA)

1. वयस्क पुरुष - 17 मिलीग्राम
2. वयस्क महिला - 21 मिलीग्राम
3. गर्भवती महिला - 35 मिलीग्राम
4. धात्री महिला - 25 मिलीग्राम

## एनीमिया की जांच हेतु मापदंड

| आयु वर्ग | हीमोग्लोबिन (ग्राम/100 मिली लीटर) | | | |
|---|---|---|---|---|
| | सामान्य | माइल्ड एनीमिया | मॉडरेट एनीमिया | सीवियर एनीमिया |
| 6 महीने से 5 साल | >11 | 10 - 10.9 | 7 - 9.9 | <7 |
| 5 से 11 साल | >11.5 | 11 – 11.4 | 8 – 10.9 | <8 |
| 12 से 14 साल | >12 | 11 – 11.9 | 8 – 10.9 | <8 |
| महिला (15 वर्ष से ज़्यादा) | >12 | 11 – 11.9 | 8 – 10.9 | <8 |
| गर्भवती महिला | >11 | 10 – 10.9 | 7 – 10.9 | <7 |
| पुरुष | >13 | 11 – 12.9 | 8 – 10.9 | <8 |

## एनीमिया के प्रतिकूल प्रभाव

### अल्प शारीरिक विकास
- कार्यक्षमता में कमी
- रोग प्रतिरोधक शक्ति में कमी
- संक्रामक रोगों में वृद्धि

### अल्प प्रजनन क्षमता
- अनियमित मासिक धर्म
- नवजात शिशु के वज़न में कमी
- समयपूर्व प्रसव

### अल्प बौद्धिक क्षमता
- बच्चों में एकाग्रहीनता
- सीखने की क्षमता में कमी

## आयरन के मुख्य स्रोत

### सब्ज़ियां

### फ़ल

### सूखे मेवे

# बाजरा

मरूस्थलीय आयुर्विज्ञान अनुसंधान केन्द्र
(भारतीय आयुर्विज्ञान अनुसंधान परिषद)
नई पाली रोड, जोधपुर – 342005

**राजस्थान में मुख्यतः खाया जाने वाला अनाज बाजरा है। बाजरे में पाया जाने वाला प्रोटीन गेहूं की अपेक्षा अधिक सुपाच्य होता है। बाजरे में गेहूं और चावल की अपेक्षा अधिक आयरन और जिंक (जस्ता) होता है ।**

**बाजरा**
**8.0 मिलीग्राम/ 100 ग्राम**

**गेहूं**
**5.3 मिलीग्राम/ 100 ग्राम**

**चावल**
**0.7 मिलीग्राम/ 100 ग्राम**

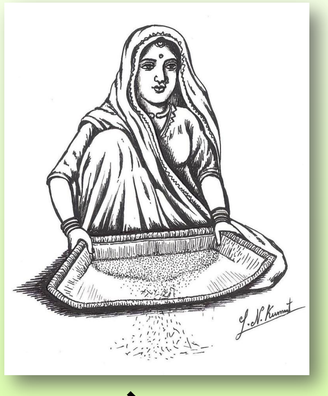
**बाजरे को उपयोग करने की विभिन्न विधियों से आयरन अवशोषण अलग अलग प्रकार से प्रभावित होता है, अतः उपयोग करते समय विधियों पर ध्यान देना आवश्यक है ।**

## 1. राब

**(आयरन- 10.5 मि.ग्रा./ 100 ग्राम)**

बाजरा भिगोना

कूटना



छाज से फटकना

कुटी हुई राब

**(आयरन- 5.29 मि.ग्रा./ 100 ग्राम)**

बाजरे का आटा

आटे से राब बनाना

आटे की राब



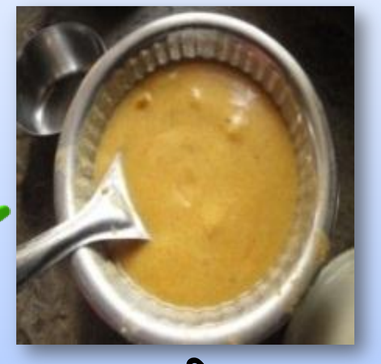
## 2. सोगरा

लोहे का तवा
(9.99 मि.ग्रा./100 ग्राम )

मिट्टी का तवा
(6.31 मि.ग्रा./100 ग्राम)

## 3. कढ़ी

बाजरे का आटा



कढ़ी
(6.39 मि.ग्रा./100 ग्राम)

# आयरन अवशोषण बढ़ाने के उपाय

मरूस्थलीय आयुर्विज्ञान अनुसंधान केन्द्र
(भारतीय आयुर्विज्ञान अनुसंधान परिषद)
नई पाली रोड, जोधपुर – 342005

**खाने के साथ एन्हैंसर्स** (वृद्धिकारक विटामिन सी /खमीरीकरण /अंकुरण / डीहस्किंग (बाजरे का कूटना और फटकना)- आयरन के अवशोषण को बढ़ाने में मदद करते हैं

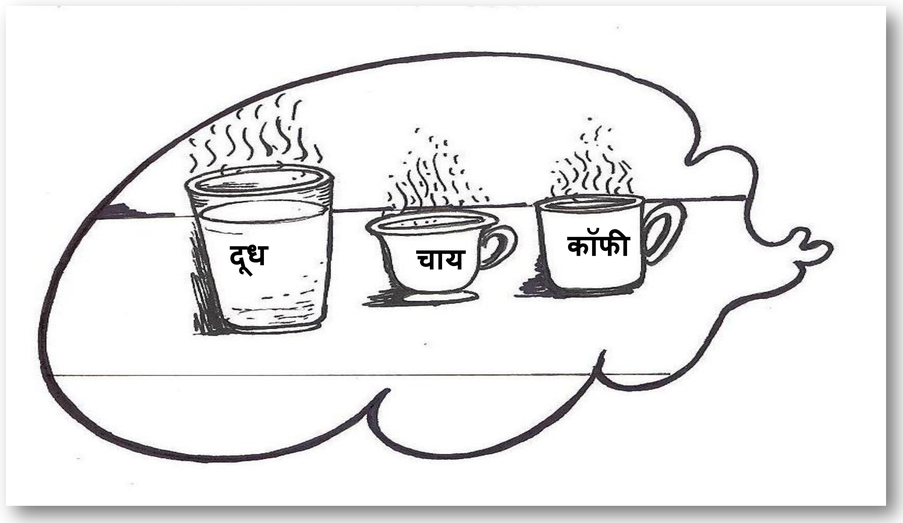
## 1. विटामिन-'सी'

## 2. अंकुरित दालें

**बाजरे को भी अंकुरित करने से छिलके में उपस्थित फाइटेट और पॉलीफेनोल की मात्रा कम हो जाती है।**

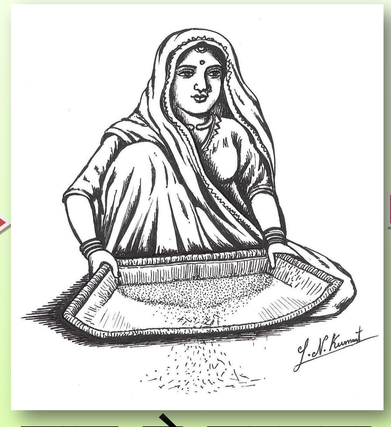
**इनहिबिटर्स** (अवरोधक: चाय/ कॉफी/दूध /पोलीफिनोल्स/ फाइटेट) **ये आयरन के अवशोषण को कम करते हैं**

## 1. खाने से दो घंटे के अंतराल पर खाये जाने वाले पदार्थ




## 2. बाजरे का आटा पिसवाने की विधि

भिगोना व कूटना



छाज से फटकना

बाजरे का आटा

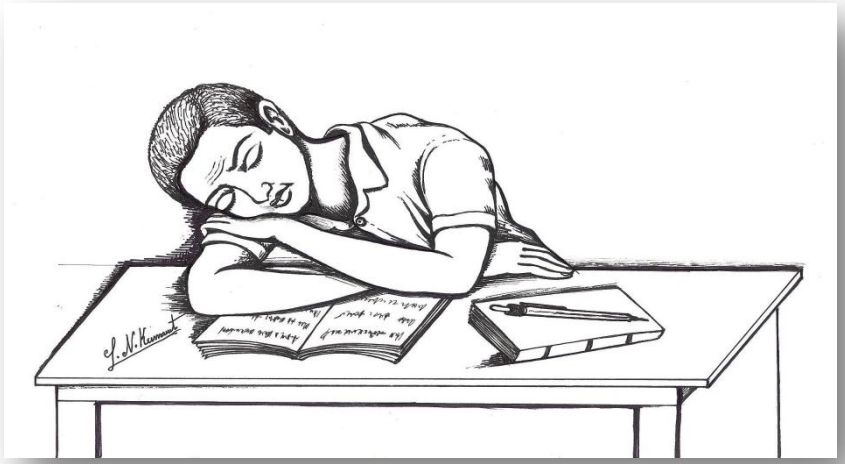

मरूस्थलीय आयुर्विज्ञान अनुसंधान केन्द्र
(भारतीय आयुर्विज्ञान अनुसंधान परिषद)
नई पाली रोड, जोधपुर - 342005


# आयरन अवशोषण हेतु बाजरे से बने भोज्य पदार्थों की विभिन्न विधियों को प्रोत्साहन देना और एनीमिया को नियंत्रित करना

# आयरन क्या है ?

आयरन (लौह तत्व) एक खनिज है जो खाद्य पदार्थों में पाया जाता है। रक्त में ऑक्सीजन के प्रवाह को बनाए रखने में आयरन की अत्यन्त महत्वपूर्ण भूमिका है। आयरन की कमी से एनीमिया होता है।

## एनीमिया के लक्षण



# प्रतिदिन खाने में आयरन की आवश्यक मात्रा (RDA)

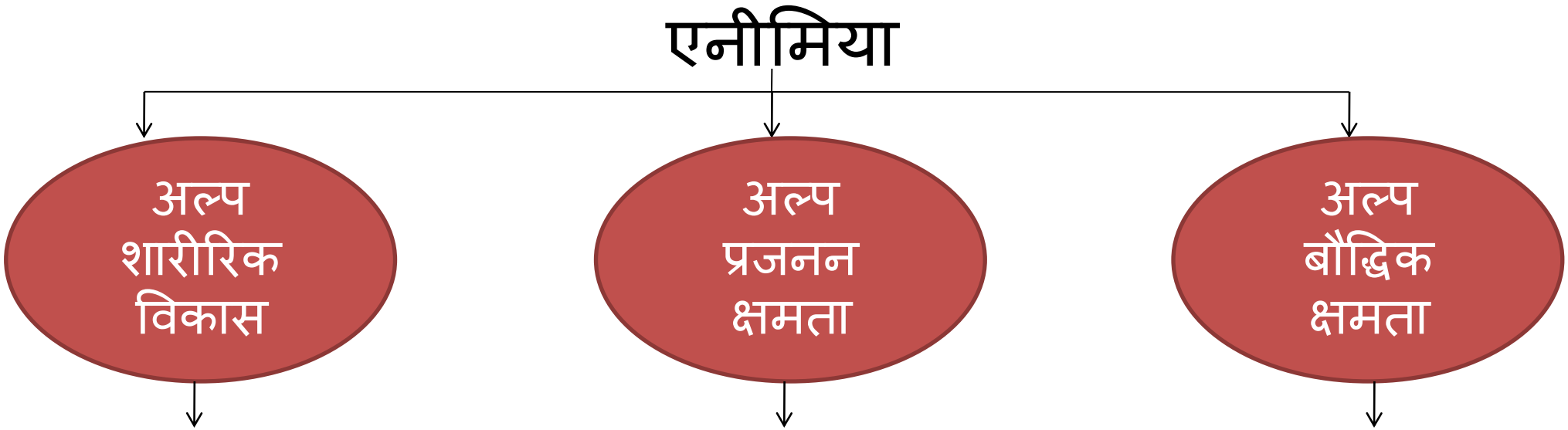
1. **वयस्क पुरुष-** 17 **मिलीग्राम**
2. **वयस्क महिला-** 21 **मिलीग्राम**
3. **गर्भवती महिला-** 35 **मिलीग्राम**
4. **धात्री महिला–** 25 **मिलीग्राम**

लौह तत्त्व शरीर में **हीमोग्लोबिन** बनाने में सहायक होता है। **हीमोग्लोबिन** से विभिन्न कोशिकाओं में **प्राणवायु (ऑक्सीजन)** का संचार होता है ।

# एनीमिया की जांच हेतु मापदंड

| आयु वर्ग | हीमोग्लोबिन (ग्राम/100 मिली लीटर ) | | | |
|---|---|---|---|---|
| | सामान्य | माइल्ड एनीमिया | मॉडरेट एनीमिया | सीवियर एनीमिया |
| 6 महीने से 5 साल | >11 | 10 - 10.9 | 7 - 9.9 | <7 |
| 5 से 11 साल | >11.5 | 11 – 11.4 | 8 – 10.9 | <8 |
| 12 से 14 साल | >12 | 11 – 11.9 | 8 – 10.9 | <8 |
| महिला (15 वर्ष से ज़्यादा) | >12 | 11 – 11.9 | 8 – 10.9 | <8 |
| गर्भवती महिला | >11 | 10 – 10.9 | 7 – 10.9 | <7 |
| पुरुष | >13 | 11 – 12.9 | 8 – 10.9 | <8 |

# एनीमिया के प्रतिकूल प्रभाव



# अनाज

**बाजरा**
**8.0 मिलीग्राम/ 100 ग्राम**

**गेहूं**
**5.3 मिलीग्राम/ 100 ग्राम**

**चावल**
**0.7 मिलीग्राम/ 100 ग्राम**

बाजरे में गेहूं और चावल की अपेक्षा अधिक आयरन और जिंक होता है।

# राब

बाजरा भिगोना

कूटना

छाज से फटकना

राब

# राब

बाजरे का आटा

आटे से राब बनाना

राब

# सोगरा

लोहे का तवा

मिट्टी का तवा

# कढ़ी

बाजरे का आटा

कढ़ी

कूटना

छाज से फटकना

बाजरे का आटा

| क्र.स. | उत्पाद | आयरन मि.ग्रा/ 100 ग्राम | जिंक मि.ग्रा/ 100 ग्राम | फाइटेट मि.ग्रा/ 100 ग्राम | पॉलीफेनोल मि.ग्रा/ 100 ग्राम |
|---|---|---|---|---|---|
| **1** | **राब-1 (बाजरे के अनाज से)** | **10.5** | **4.40** | **200.5** | **270** |
| **2** | **सोगरा** | **9.99 (लोहे का तवा)** 6.31 (मिट्टी का तवा) | **3.89** | **234.0** | **310** |
| **3** | **कढ़ी** | **6.39** | **3.74** | **267.2** | **220** |
| 4 | खीचडी (खींच) | 5.29 | 3.59 | 200.5 | 320 |
| 5 | राब-2 (बाजरे के आटे से) | 5.29 | 4.84 | 267.4 | 260 |

**खाने के साथ एन्हैंसर्स** (वृद्धिकारक विटामिन सी /खमीरीकरण /अंकुरण / डीहस्किंग (बाजरे का कूटना और फटकना)- आयरन के अवशोषण को बढ़ाने में मदद करते हैं

# विटामिन 'सी








# अंकुरित दालें

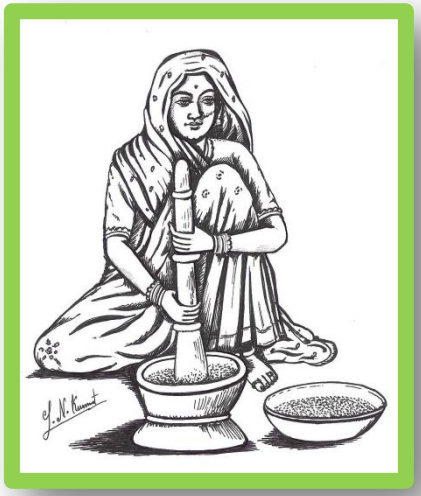


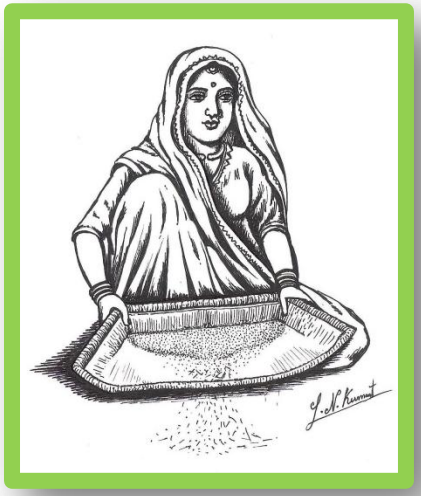
**बाजरे को भी अंकुरित करने से छिलके में उपस्थित फाइटेट और पॉलीफेनोल की मात्रा कम हो जाती है।**

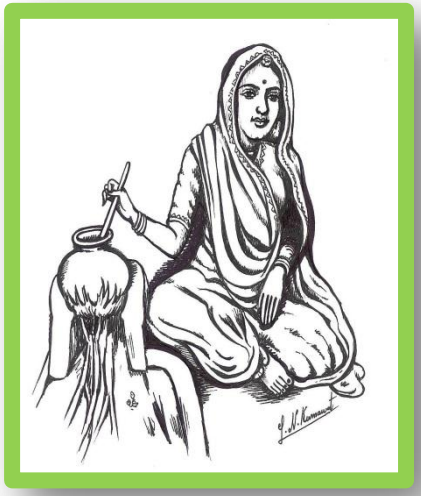
**इनहिबिटर्स** (अवरोधक: चाय/ कॉफी/दूध /पोलीफिनोल्स/ फाइटेट) **ये आयरन के अवशोषण को कम करते हैं)**

# खाने से दो घंटे के अंतराल पर खाये जाने वाले पदार्थ


भिगोना, कूटना तथा फटकने की विधि से बनाए गए बाजरे के आटे तथा व्यंजनों के नियमित सेवन से सूक्ष्म पोषक तत्वों की कमी से होने वाले विभिन्न रोग जैसे एनीमिया तथा जिंक (जस्ता) की कमी वाले रोगों से बचा जा सकता है (उल्टी-दस्त, त्वचा के रोग, रोग-प्रतिरोधक क्षमता में कमी आदि)।







# आयरन के मुख्य स्रोत

## सब्ज़ियां

## फ़ल

## सूखे मेवे

मरूस्थलीय आयुर्विज्ञान अनुसंधान केन्द्र, जोधपुर (आई.सी.एम.आर)

# आयरन अवशोषण हेतु बाजरे से बने भोज्य पदार्थों की विभिन्न विधियों को प्रोत्साहन देना और एनीमिया को नियंत्रित करना

राजस्थान में मुख्यतः खाया जाने वाला अनाज बाजरा है। बाजरे में पाया जाने वाला प्रोटीन गेहूं की अपेक्षा अधिक सुपाच्य होता है। बाजरे में गेहूं और चावल की अपेक्षा अधिक आयरन और जिंक होता है ।

**बाजरा**
**8.0 मिलीग्राम/ 100 ग्राम**

**गेहूं**
**5.3 मिलीग्राम/ 100 ग्राम**

**चावल**
**0.7 मिलीग्राम/ 100 ग्राम**

**आयरन क्या है ?** आयरन (लौह तत्व) एक खनिज है जो खाद्य पदार्थों में पाया जाता है। रक्त में ऑक्सीजन के प्रवाह को बनाए रखने में आयरन की अत्यन्त महत्वपूर्ण भूमिका है। यदि खाने में आयरन कम हो तो खून की कमी हो जाती है जिसे एनीमिया भी कहते हैं। **एनीमिया के लक्षण:- 1.** शरीर का रंग पीला पड़ जाना । **2.** नाखूनों तथा आँख के कोरों में लालिमा न होना । **3.** अत्यधिक थकान महसूस होना । **4.** चक्कर आना व सांस फूलना । **5.** बच्चों का पढ़ाई में मन न लगना ।

**प्रतिदिन खाने में आयरन की आवश्यक मात्रा (RDA) -**1. **वयस्क पुरुष**- 17 **मिलीग्राम** 2. **वयस्क महिला**- 21 **मिलीग्राम**
3. **गर्भवती महिला**- 35 **मिलीग्राम** 4. **धात्री महिला**- 25 **मिलीग्राम**

- बाजरे से मुख्य तौर पर राब, कढ़ी, सोगरा और खींच बनाए जाते हैं जिन्हें बनाने की विधियों से शरीर में आयरन अवशोषण प्रभावित होता है । बाजरे के विभिन्न उत्पादो मे से कूट के बनाई गई राब, लोहे के तवे पे बना सोगरा तथा कढ़ी अधिक लाभदायक है अतः हमें इन भोज्य पदार्थों को बनाने की विधियों पर विशेष ध्यान देना चाहिए जो निम्नलिखित है –

1. **बाजरे की राब को बनाने के लिये पहले बाजरे को पानी में भिगोना, कूटना, छाज से फटकना और फिर उसे पकाना चाहिए। इस विधि से बनाने पर राब में अधिक आयरन (10.5 मिलीग्राम/ 100 ग्राम) प्राप्त होगा यह विधि बहुत लाभदायक है।**

**बाजरा भिगोना**

**कूटना**

**छाज से फटकना**

**राब**

2. **बाजरे के आटे से राब नहीं/ कम बनानी चाहिए क्योंकि इससे बनने वाली राब में केवल 5.29 मिलीग्राम/ 100 ग्राम आयरन ही प्राप्त होगा जो कि ऊपर वाली विधि से लगभग आधी मात्रा में कम है ।**

**बाजरे का आटा**

**आटे से राब बनाना**

**राब**

3. **सोगरा बनाने के लिये लोहे का तवा बहुत लाभदायक है क्योंकि इस पर बनने वाले सोगरे में अधिक आयरन (9.99 मिलीग्राम/ 100 ग्राम) होता है, जबकि मिट्टी के तवे पर बनने वाले सोगरे में आयरन की मात्रा कम (6.31 मिलीग्राम/ 100 ग्राम) होती है।**

**लोहे का तवा**

**मिट्टी का तवा**

**4. बाजरे के आटे से बनने वाली कढ़ी का अधिक सेवन करना चाहिए, इसमें 6.39 मिलीग्राम/ 100 ग्राम आयरन होता है।**



बाजरे का आटा कढ़ी

**5. बाजरे के आटे को बनाने के लिये यदि हम बाजरे को कूट कर और छाज से फटक कर बाजरे को पिसवाएंगे तो आटे में पॉलीफिनॉल और फाइटेट की मात्रा कम होगी इससे हमारे शरीर में आयरन का अवशोषण अधिक होगा।**




कूटना छाज से फटकना बाजरे का आटा

| क्रमांक | उत्पाद | आयरन मि.ग्रा/ 100 ग्राम | जिंक मि.ग्रा/ 100 ग्राम | फाइटेट मि.ग्रा/ 100 ग्राम | पॉलीफेनोल मि.ग्रा/ 100 ग्राम |
|---|---|---|---|---|---|
| 1 | राब-2 (बाजरे के अनाज से) | 10.5 | 4.40 | 200.5 | 270 |
| 2 | सोगरा | 9.99 (लोहे का तवा)<br>6.31 (मिट्टी का तवा) | 3.89 | 234.0 | 310 |
| 3 | कढ़ी | 6.39 | 3.74 | 267.2 | 220 |
| 4 | खीचडी (खींच) | 5.29 | 3.59 | 200.5 | 320 |
| 5 | राब-2 (बाजरे के आटे से) | 5.29 | 4.84 | 267.4 | 260 |

## कुछ महत्वपूर्ण आहारीय परामर्श

**एन्हैंसर्स (वृद्धिकारक विटामिन सी /खमीरीकरण /अंकुरण / डीहस्किंग (बाजरे का कूटना और फटकना)- आयरन के अवशोषण को बढ़ाने में मदद करते हैं**

- खाने के साथ विटामिन 'सी' का भी उपयोग करना चाहिए तभी आयरन का पूरा लाभ शरीर को मिल पाता है जैसे- नींबू, काचरा, नारंगी, हरी मिर्च, आवला, अमरूद, और ताजे फल व सब्जिया आदि। जो की शरीर में आयरन अवशोषण को बढ़ाते हैं जिससे खून की कमी दूर होती है। खाने के साथ खट्टी छाछ व ताजे फलो के रस के उपयोग से भी आयरन अवशोषण बढ़ता है।
- नाश्ते में अंकुरित दालों का सेवन करना चाहिए जैसे की मूंग, मोठ, चना आदि का जो कि आयरन के अवशोषण को बढ़ाने में मदद करते हैं।
- बाजरे को भी अंकुरित करने से आयरन का अवशोषण बढ़ जाता है। अंकुरण से बाजरे के छिलके में उपस्थित फाइटेट और पॉलीफेनोल की मात्रा कम हो जाती है।
- खाद्य पदार्थों के खमीरीकरण से भी आयरन का अवशोषण बढ़ जाता है।

**इनहिबिटर्स(अवरोधक चाय/ कॉफी/दूध /पोलीफिनोल्स/ फाइटेट ये आयरन के अवशोषण को कम करते हैं)**

- चाय, कॉफ़ी, दूध और खाने के बीच कम से कम दो घंटे का अंतर होना चाहिए । क्योंकि चाय और कॉफ़ी में उपस्थित टैनिन्स और फाइटेट आयरन के अवशोषण को कम कर देते हैं ।
- भिगोना, कूटना तथा फटकने की विधि से बनाए गए बाजरे के आटे तथा व्यंजनों के नियमित सेवन से सूक्ष्म पोषक तत्वों की कमी से होने वाले विभिन्न रोग जैसे एनीमिया तथा जिंक की कमी वाले रोगों से बचा जा सकता है।
- सूक्ष्म पोषक तत्वों की कमी- एनीमिया (आयरन की कमी), विटामिन ए की कमी (रतौंधी), जिंक की कमी, आयोडीन आदि की कमी।

**आयरन के अन्य मुख्य स्रोत**

हरी पत्तेदार सब्ज़ियाँ , हरी फलियां, पालक, शलजम, शकरकंद, चुकंदर, चना, किशमिश, बादाम आदि

**फलों में-** खजूर, अनार, तरबूज, सेब, अंगूर आदि