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Revision of ration scale for Pakistani servicemen according to geographical deployment and physical activity level

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Abstract

Optimum nutritional status is important to derive maximum benefits of training the forces and it can affect health status and wellbeing of the servicemen. The present study was conducted to explicate the nutritional composition of different food items in the standard ration as well as device ration of servicemen considering geographical deployment location and physical activity level of servicemen keeping in view food guidelines standards of nutrients. Accordingly, food items of the selected rations were collected from different suppliers and were analyzed using food analysis techniques by AOAC. Results indicated carbohydrates content of 722.11 + 26.4 g (71.37%), fats 164.19 + 14.5 g (16.22%) and proteins 125.36 + 11.2 g (12.39%) as well as total caloric contents of 4867.59+ 205 Kcal/soldier/day. Further, Soldiers deployed at higher altitude *i.e.*, at 15000 feet above sea level supplied with extra rations to cope up extra caloric requirement and replacement of fresh fruits and vegetables. Suggested caloric plan was advised for 4045.85 ± 114 kcals and macronutrients distribution of carbohydrates (68%), fats (17.5%) and proteins (14.5%) were recommended. Conclusively, calorie density of existing ration scale was higher which needs to be rationalization and nutrition awareness programs should be conducted to increase the knowledge of servicemen for better health and nutrition status.

Keywords: ration scale; duty area; physical activity; nutritional requirement; servicemen; optimal health.

Practical Application: The health status of servicemens directly related to amount and quality of food provided along with physical activity level for servicemen. In this regard, present study provides insights relevant to ration scale provided to Pakistani Servicemen with respect to geographical deployment and physical activity level as nutritional intake and composition is very vital in serviceman life. This ration scale not assessed previously with respect to the nutrient composition and requirement. Therefore, present study designed to determine nutritional composition of different items in existing ration items and suggest changes in ration scale considering nutritional needs of servicemen according to the geographical locations and physical activity level. Findings of this study are useful for the army professionals along with peoples engaged with nutritional status and health of the army personnel's in Pakistan.

1 Introduction

The zeal and enthusiasm which a soldier show in performing duties and recovery from ailments/injuries is dependent on health as well as nutritional status of the food servicemen are provided (Horsfall, 2017). Among three basic requirements of human including food, clothing, and shelter, food plays a vital role especially in military personnel as they are always engaged in the training activities or fighting fit condition. The optimum nutritional status is vital to derive maximum benefits of training and operational tasks for servicemen as this becomes more important in militaries like Pakistan in which soldiers deployed in diverse locations ranging from plain fields operations to higher mountains like Siachen. The military nutritional requirement has to be task oriented to keep them physically fit all times as they experience different environmental conditions and combat situations (Haskell et al., 2007). In many situations, they are forced to be restricted to canned/precooked food as fresh food is difficult to be supplied in these situations, nutritional status of servicemen is compromised (Babusha et al., 2008).

It has been documented in the literature that 'the army fights on its belly' and food supplies rank equally important for the servicemen as supply of ammunition and gasoline. Additionally, modern day army however is not only provided with palatable food but also nutrient dense for maintaining servicemen health and recover ailment/injuries (Farina et al., 2017). Many times, soldier may not carry adequate quantities of food with them owing to the compulsion of taking ammunition and thus severely injured can go into catabolic state of negative energy balance. At best medical center's, recovery can span up to months. The latest thinking in nutritional support is that it's

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not simply the prevention of nutritional deficiency rather it is a method of treatment that may have positive impact on final performance and nutritional status of soldiers (Ainslie, 1975; Leslie et al., 1984).

Military servicemen frequently encounter metabolically demanding operations under conditions of environmental extremes thus their daily energy requirements reported to range from sedentary levels to as high as 10,000 kcal. Also, success of the operations is determined by ability to adapt to extreme conditions, including those adaptations linked with adequate nutrition. Additionally, extreme climatic conditions also affect nutritional needs of servicemen either extreme high or low temperature impose additional requirement of 5-10% calories along with proper hydration status (Fallowfield et al., 2014; Tharion et al., 2005).

The sweat rates in solders who perform duties in dry and hot conditions is around 1 L/min which need to be replenished from different fluids like juices, smoothies, drinks or even water etc. or adding small quantities of sodium to drinking water which cause a better water retention then the same volume of plain water. The provision of carbohydrate proved to be best source of energy in performing duties in hot climate. It is Suggested that intake of carbohydrate be met via beverages providing 4-8 g carbohydrate per 100 mL (An isotonic drink to human body) as it provides extra carbohydrate along with better absorption through intestines (Hibbert-Jones & Regan, 2005). To provide customized ration to every soldier according to his specific requirement as per environment, body stature and nature of duty, United States army is planning to 3D print food for every soldier till 2025 (Kruger, 2017).

Poor intake of nutrition is a part of behavior and it affect the health and well-being of the servicemen. "Poor nutritional and dietary habits affect feel look, think and act. A bad diet results in lower core strength, slower problem-solving ability and muscle response time, and less alertness". The author further stated that poor nutrition adversely effects on health. Poor nutrition early in life can impair neural development, leading to lower IQ in humans being. Development and growth of the body directly concerned with nutrition and diet use by a person on daily basis. Use of balance diet helps one to stay healthy and to perform the social activities in beneficial manner. Lack of balance diet has adverse effect on overall structural and functional capacity of then body (Ross et al., 2012).

Although basic principles of nutrition are same for common peoples as well as for military, but military nutrition has to be viewed differently from civilian as they are exposed to different stressful situations like environmental extremes, hypoxia, etc. and always lead regimental and directed life. This demand uniform standard in nutrient supplies/uptake be it during peace time/operational areas to strengthen physiological nutritional reserves for the days of inadequate supplies or in situation where they are forced to consume processed rations depending on logistics of situation. Additionally, soldier may have to skip his ration in preference to arms and ammunition that can also affect body's nutritional reserves (Babusha et al., 2008). The servicemen of Pakistan army are provided with specific amount of ration items issued on daily basis to kitchen staff for cooking for the army servicemen as well as soldiers. They are provided fresh and processed food items depending on the location of the unit, availability of the food items as well as seasonality. Although Pakistan Armed Forces pay considerable attention and priority to feed their soldiers but no efforts made to comprehensively review nutritional composition of food items in existing ration scale. Moreover, the servicemen of the Pakistan army are provided same ration items either deployed on the plains as well as on the mountains. There are no segregation of the ration scale items for the servicemen considering the deployment of the army personnel's and physical activity. Considering the circumstances, present study was conducted to determine the nutritional composition of different items in the existing ration items as well as suggest changes in the ration scale considering the nutritional needs of the servicemen according to the geographical locations and physical activity level.

2 Material and methods

The present study conducted with support of Armed Forces Institute of Nutrition and Department of Food Science and Human Nutrition, University of Veterinary and Animal Sciences, Lahore Punjab, Pakistan with objective to evaluate nutritional composition of food items included in the standard ration pack provided to servicemen and also device ration scale to army personnel considered geographical location, nutritional needs and physical activity level of servicemen. The target area was whole Pakistan as servicemen deployed across the country with emphasis to troops deployed at Snow hilly areas, deserts and plains. The three straits formed are as follows; Snow Hilly Areas including Siachen, Gilgit, Skardu, and Waziristan; Desert Areas: It included Pano Aqil, Hyderabad, Chhor, and Rahim Yar Khan and Plains as city cantonments including Lahore, Karachi, Rawalpindi, and Peshawar.

2.1 Sampling of food items of the existing ration

For the purpose of study, all individual food items collected from various field units and carried to laboratory in sealed containers and were analyzed at Armed Forces Institute of Nutrition (AFIN) Lahore cantonment and Food analysis Laboratory at the Department of Food Science and Human Nutrition, University of Veterinary and Animal Sciences, Lahore. The food samples selected considering geographical zones *as* South, Central, North 1 and North 2 regions according to procurement and distribution of dry ration items for servicemen.

2.2 Analysis of food items

The quality of dry ration items like tea, flour, rice, pulses, oil/ghee is fairly constant as all these items are analyzed at Armed Forces Institute of Nutrition (AFIN), Lahore on regular basis especially before procurement, but the fresh ration items like fresh fruits, vegetables, meat and fresh milk supplied by local contractors/vendors and their quality varies as well as of different varieties in every local military cantonment and operational area. These items are supplied according to the availability in local market and season. For the purpose of the study fresh ration, items were collected from various military cantonments and average values of raw food have been used in the study.

The moisture and ash contents were determined following the methods described in AOAC method no. 934.01 and method no. 942.05 respectively (Association of Official Analytical Chemists,

2006). For moisture determination, sample was placed in the drying oven at 100 ± 4 °C for 24 time until constant weight was obtained. The ash contents were determined following the methods described in AOAC method no. 934.01 and method no. 942.05 respectively (Association of Official Analytical Chemists, 2006). For ash determination Muffle Furnace (Gallenhamp, England) was used. The crude fat content was determined by using Soxhlet following the method described in AOAC method no. 920.39 (Association of Official Analytical Chemists, 2006). The crude Fat was calculated using the following formula described as Crude Fat (%) = (weigh of fat in sample/ weight of sample) × 100. The crude protein contents were determined using Kjeldahl method following sample digestion, distillation and titration replicating the procedure described in AOAC method no. 984.13 (Association of Official Analytical Chemists, 2006). The nitrogen content was calculated by using the following formula. Nitrogen (%) = [{(volume of H2SO4 × 0.0014 × 250)/(weight of sample × volume of sample taken)}The × 100] and the crude protein percentage was determined by multiplying nitrogen with a factor 6.25 as follows: Crude Protein = Nitrogen (%) × 6.25. The crude fiber was analyzed through method no. 978.10 (Association of Official Analytical Chemists, 2006) and Nitrogen free extract (NFE) calculated using the subtraction method as described in (Association of Official Analytical Chemists, 2006).

2.3 Mineral analysis

The mineral contents of the ration items selected for nutritional analysis were determined using flame photometry and Atomic Absorption Spectrophotometer following the methods described in (Sikirić et al., 2003). Exactly 1 g/mL sample was taken in the conical flask following by addition of 7 mL HNO3 and 3 mL HClO4 was added and then sample were digested until clear or sea green solution is achieved. The Total volume was made up to 25 mL after getting clear appearance. Along with standards samples were then analyzed using Atomic Absorption Spectrophotometer. The absorbance of the standard solutions plotted using software and values of the different minerals were calculated by following the protocol of the (Sikirić et al., 2003).

2.4 Vitamin analysis of food items

The vitamins level including Thiamine, vitamin A, D and C of selected food items in ration scale of servicemen were assessed using method no. 942.23, 992.04, 936.14 and 967.21 respectively following the instructions described by (Association of Official Analytical Chemists, 2006).

2.5 Energy value estimation

The total caloric value of different items in ration scale provided to the service members assessed using the bomb calorimeter that involves measurement of heat created by a sample burning under an oxygen atmosphere in closed vessel (bomb), which is surrounded by water, under controlled conditions by following the procedure described by (Manzi et al., 2004).

2.6 Statistical analysis

The collected data was analyzed using Statistical Package for Social Sciences (SPSS Inc. Chicago, IL, USA) Version 25.0 by following the guidelines of (Steel & Torrie, 1980). Descriptive statistic used to define and represent data and the findings reported in Means ± SD as well as percentage. Results were considered significant at (p-value < 0.05).

3 Results and discussion

The present study was conducted to evaluate the nutritional composition of the existing ration scale including food items to the servicemen to meet their nutritional needs as well as suggest changes in the menu of the ration scale of the servicemen. The results of study are described in below mentioned headings

3.1 Calculation of macro and micronutrients

The authorized scale of each food item and their macronutrient percentage and weight are given in (Table 1) that indicated that ration of the servicemen mainly include Wheat Flour, Rice, Pulses, Cooking Oil, Sugar, Whole Milk Powder / Milk Fresh,

Table 1. Nutritional composition of various food items provided in ration to the servicemen.

No.	Commodity	Macronutrients (g)			
		Quantity in (g)	Carbohydrate	Fat	Protein
1	Wheat Flour	669.8	492.44 ± 34.47	8.71 ± 0.7	60.28 ± 6.03
2	Rice	30.2	24.16 ± 2.17	0.11 ± 0.01	2.11 ± 0.15
3	Pulses	101.5	58.87 ± 4.71	1.9 ± 0.13	20.3 ± 1.62
4	Cooking Oil/Ghee	100	0 ± 0	99.8 ± 6.99	0.2 ± 0.01
5	Sugar	70	70 ± 4.9	0 ± 0	0 ± 0
6	whole milk powder / milk fresh	248	11.65 ± 1.17	21.84 ± 1.53	10.4 ± 0.83
7	Vegetable	198	12.33 ± 0.86	0 ± 0	3.18 ± 0.32
8	Onion fresh	56	4.8 ± 0.38	0 ± 0	0.72 ± 0.06
9	Potato	113	20.21 ± 1.41	0.12 ± 0.01	2.02 ± 0.16
10	Mutton	52.73	0 ± 0	9.41 ± 0.66	8.91 ± 0.71
11	Beef	60.26	0 ± 0	13.51 ± 1.35	7.65 ± 0.69
12	Chicken	43.2	0 ± 0	7.53 ± 0.53	8.15 ± 0.73
13	Eggs	5.33	0 ± 0	0.58 ± 0.05	0.66 ± 0.05
14	Non-Citrus Fruits	226	27.65 ± 1.94	0.68 ± 0.06	0.78 ± 0.07

Vegetables, Onion fresh, Potato, Mutton, Beef, Chicken, Eggs and Non-Citrus Fruits. Among these few of the items like wheat flour, sugar etc. provided on daily basis whereas, item like mutton, beef, chicken and eggs provided on selected days of the week. Results also indicated that each serviceman regardless of the geographical location and physical activity level is issued 670 g wheat flour, rice is 30.2, pulses 101 g, oil/ghee is 100 g, sugar is 70 g, whole milk powder is 248 g, whereas the Mutton is 52.73, Beef is 60.26, Chicken is 43.2 and Eggs are 5.33 g on daily basis. As the animal origin, foods excluding milk is not provided on daily basis so the quantity provided in the whole week is divided to calculate daily value of each food commodity. Also, the milk provided is mainly used for the preparation of the tea with 1 cup (serving tea) is 220ml made with tap water and milk. The values calculated are of those food items, which are included in the daily ration scale of service members irrespective of their rank and at all areas across Pakistan. The total amount of macronutrients in a typical Pakistani soldier's diet is as Carbohydrates 722.11 gm (71.37%), Fats 164.19 gm (16.22%) and Proteins 125.36 gm (12.39%). The total calories calculated /day/ soldier from the above data comes to be 4867.59 calories.

The soldiers at high altitude *i.e.,* at or above 15000 feet above sea level supplied with extra rations to cope up extra caloric requirement of extremes of temperature, (especially cold) increases about 10% the caloric requirement below freezing point (Ahmed et al., 2020). The additional food items including vegetables, fruits and fresh meat cannot be supplied at high altitudes due to logistic problems of accessibility and high cost therefore, canned fruits, vegetables and meat are supplied to meet the nutritional needs that can also be stored for long periods, and used by soldiers even transport means disrupted in cold winter season. Additionally, all the meals are prepared according to typical Pakistani cuisine and keeping in view the likings of the servicemen with detail of the caloric value of the canned food items is provided in (Table 2) that include items such as gur (raw sugar), potato tinned, onion dehydrated, butter tinned, canned vegetables, fruit tinned, meat tinned, fruit dried, drink powder, mixed pickle in oil, jam, honey, kheer /firni Mix, canned beef korma & chicken and parched grams (Table 3).

Since extra ration and canned foods supplied as replacement of fresh food due to the logistics issues and weather constraints, the daily caloric of service men deployed at high altitudes and the total calories of extra ration is 1098.5. After subtracting the caloric value of all fresh ration items (As they are replaced by tin items), the calorie calculation is 4867.59 - 1920.24 = 2947.35. By adding caloric value of extra ration items, the total calories are 4045.85. Additionally, nutritional composition/value of high-altitude service men ration is low than that of plains as it is considered sufficient considering requirement of soldiers deployed in these areas. As it is generally considered that service men at high altitude/mountainous snow with clad terrain having restrained movement as well as duties are mostly sedentary in nature but at same time the corresponding requirement of calories at high altitude is more compared to ground level. This scenario demands the division of the ration to the soldiers considering the physical activity level as well as geographical location for the deployment of the soldiers in different working areas of the country.

During recent times, the role of military and nature of military operations has become diverse in nature as now success of operation mostly depended on swift, prompt and highly specialized operational activity in areas not previously known to the soldiers even with limited logistics facilities. This situation also creates and demand to combat situation by service men to carry specially prepared rations along with them to meet their

Table 2. Caloric value of extra ration items per day per person.

No	Commodity	Calories (kcal)/g	Quantity Authorized (g) (Per person)	Total Calories
1	Gur (Raw Sugar)	3.83	8	30.64
2	Potato Tinned	0.76	37	28.12
3	Onion Dehydrated	0.23	14	3.22
4	Butter Tinned	7.4	28	207.2
5	Vegetable Tinned	0.09 (Cauliflower) 0.19 (beans)	70	8.4
6	Fruit Tinned	0.46 (Pineapple) 1.06 (Apricot) 0.87 (Peaches)	85 (3 issues in a week so daily allowance is 36.42)	34
7	Meat Tinned	2.23	25	55.75
8	Fruit dried	2.48 (Dates dried) 2.13 (Figs)	28 (3 issues in a week so daily allowance is 12	27.6
9	Drink Powder	3.6	87	313.2
10	Mixed Pickle in Oil	1.34	10	13.4
11	Jam Tinned	2.62	12.5	82.75
12	Honey	2.88	15	43.2
13	Kheer /Firni Mix	1.31	27	35.37
14	Beef Korma Tinned	2.23	25	55.75
15	Chicken Tinned	1.48	96	142.08
17	Gram Parched	0.81	22	17.82

Table 3. Nutritional composition of major food recipes provided in the ration of servicemen.

Recipes	Ingredients	Quantity (g)	Fats (g)	Protein (g)	Carbohydrates (g)	Calories	Total calories
Beef Korma	Beef	510	94.86	90	0	1214	1934
	Ghee/Cooking oil	80	80	0	0	720	
Chicken Curry	Chicken	425	73.9	78.96	0	981	1701
	Vanaspati Ghee	80	80	0	0	720	
Potato with green pea	Potatoes	382.5	0.76	7.22	73.34	329	1318
	Peas	382.5	1.7	22.45	40.92	269	
	Vanaspati Ghee	80	80	0	0	720	
Boiled potatoes	Potatoes	425	0.84	7.98	81.06	364	364
Meat with green peas	Meat	544	60.48	105.84	0.5	970	1832
	Gren peas	136	0.84	12.3	21.4	142	
	Ghee/Cooking oil	80	80	0	0	720	

Table 4. Caloric value of one meal ready to eat (MRE) pack provided to the servicemen in daily ration.

No.	Commodity	Quantity	Amount (g)	Caloric value (kcal)
1	Biscuits pack	1	8	57
2	Tea bag	2	-	0
3	Tea whitener	2	16	167
4	Sugar sachet	2	14	56
5	Flavored glucose drink	1	15	54
6	Fruit dried (Dates)	5	-	115
7	Sweet bar	1	8	74
8	Nimko (Localy produced snack)	1	10	30
9	Toffee	1	4	30
10	Tang (Fruit Extract) sachet	1	12	77
11	Local Bread fried with oil	5	525	1595
12	Minced steamed Potato	1	100	120
13*	Chicken curry	1	100	234
	Beef curry	1	100	266
	Minced meat with potatoes	1	100	194

*Indictaed that the food items included chicken curry, beef curry and mutton curry can be taken once out of these 3 food dishes.

nutritional requirement at least for short periods in these tough circumstances (Pasiakos, 2020). Considering the requirement, MRE (meal ready to eat) has been introduced around the globe which is a meal packed either in an aluminum foil, polythene bag or tinned, prepared and eaten with ease and carried by each individual (Hart et al., 2018). Pakistani army has also introduced MRE with items as precooked, are in line with the likings of the troops and as per local traditions and tastes. The MRE pack typically consists of three large strong aluminum foil packs, which contain three main meals *i.e.,* breakfast, lunch and dinner along with tea bags, tea whitener, dry fruit, sugar sachets, dry flavored fruit drink powder, matches, and a small burner and metal stand to warm food. The various dishes included in a typical Pakistani MRE pack and its nutritional value is mentioned (Table 4).

3.2 Division of vitamins and minerals of selected ration items

After comparison of food analysis of various armed forces, of both macro and micronutrients and comparing them with the national and international standards /requirements and taking into account kitchen and plate wastages, following are the findings/ recommendations. The micronutrients including vitamins and minerals are responsible for various metabolic and energy pathways in the body and are as important as the macronutrients. The minerals quantification of the ration provided to servicemen contain approximately 1291.52 ± 98.32 mg calcium, 2118.2 ± 150.9 mg phosphorus, 50.49 ± 4.24 mg iron, 32.56 ± 2.08 mg zinc and 91.1 ± 7.73 ug iodine. On an average, the vitamins quantified in various foods of ration provided to the servicemen were 7.04 ± 0.51 mg thiamine, 155.8 ± 9.37 mg ascorbic acid, 1437.8 ± 109.14 retinol equivalent vitamin A and 17.62 ± 2.25 vitamin D. The ration was also providing 226.48 ± 14.42 mg cholesterol per day (Table 5). The micronutrient quantification does not include the citrus and non-citrus fruits and various vegetables provided to the servicemen in the daily ration. All the micronutrients calculated in the below mentioned micronutrients analysis were adequate with respect to the guidelines provided by American dietetic Association (Raymond & Morrow, 2020; Smith et al., 2018).

Table 5. Minerals and vitamins quantification of various food items provided in ration to servicemen.

Items	Quantity	Minerals (mg)					Vitamins (mg)				Cholesterol
		Ca	P	Fe	Zn	I (ppm)	B1	C	A (RE)	D (IU)	
Atta	670	214.4 ± 19.3	723.6 ± 43.42	30.15 ± 2.71	19.43 ± 1.17	ND	2.01 ± 0.12	ND	ND	ND	ND
Rice	30.2	5.4 ± 0.38	38.4 ± 3.84	0.45 ± 0.04	0.36 ± 0.03	ND	0.04 ± 0	ND	ND	ND	ND
Pulses	101.5	122 ± 7.32	318 ± 31.8	7.8 ± 0.55	3.1 ± 0.16	ND	0.52 ± 0.05	5 ± 0.45	4 ± 0.24	ND	ND
Cooking oil	100	0.5 ± 0.03	1.5 ± 0.15	0.01 ± 0	ND	ND	ND	ND	512 ± 46.08	ND	ND
Sugar	70	4.5 ± 0.36	0.7 ± 0.07	0.4 ± 0.02	ND	1.6 ± 0.16	ND	ND	ND	ND	ND
Milk (Fresh)	248	312 ± 24.96	214 ± 19.26	0.8 ± 0.05	0.5 ± 0.05	2.5 ± 0.18	0.1 ± 0.01	2.2 ± 0.2	112 ± 6.72	4 ± 0.2	34 ± 2.38
Vegetable Fresh	198	46 ± 3.68	97 ± 4.85	3.7 ± 0.3	0.7 ± 0.06	ND	0.36 ± 0.02	92 ± 4.6	468 ± 32.76	ND	ND
Onion	56	16 ± 0.8	23 ± 1.15	0.4 ± 0.04	0.1 ± 0.01	44 ± 3.52	0.03 ± 0	6 ± 0.42	ND	ND	ND
Potato	113	10.7 ± 0.54	49 ± 2.94	0.9 ± 0.07	0.5 ± 0.03	11 ± 0.99	0.14 ± 0.01	16 ± 1.28	ND	ND	ND
Mutton	52.73	5.4 ± 0.49	81 ± 8.1	1.4 ± 0.14	2.4 ± 0.19	ND	0.9 ± 0.09	ND	ND	0.55 ± 0.03	36 ± 2.16
Beef	60.26	7 ± 0.7	82 ± 6.56	1.3 ± 0.06	0.5 ± 0.03	ND	0.04 ± 0	ND	ND	0.12 ± 0.01	46 ± 3.22
Chicken	43.2	7 ± 0.63	88 ± 7.92	0.9 ± 0.05	0.6 ± 0.05	32 ± 2.88	0.04 ± 0	ND	7 ± 0.56	ND	34 ± 1.7
Eggs	2/month	3.62 ± 0.18	14 ± 0.84	0.18 ± 0.01	0.07 ± 0	ND	2 ± 0.16	ND	12.8 ± 1.28	3.5 ± 0.21	28.48 ± 2.56
Fresh Fruit	226	68 ± 6.12	20 ± 1.6	1.8 ± 0.18	2.2 ± 0.13	ND	0.72 ± 0.04	31 ± 2.17	180 ± 14.4	ND	ND
Milk Powder	50	469 ± 32.83	368 ± 18.4	0.3 ± 0.02	2.1 ± 0.17	ND	0.14 ± 0.01	3.6 ± 0.25	142 ± 7.1	10 ± 1	48 ± 2.4
Total		1291.52 ± 98.32	2118.2 ± 150.9	50.49 ± 4.24	32.56 ± 2.08	91.1 ± 7.73	7.04 ± 0.51	155.8 ± 9.37	1437.8 ± 109.14	17.62 ± 2.25	226.48 ± 14.42

ND represents "not detected" in the sample being analyzed from the sample lot.

3.3 Suggested Ration Scale

Food and nutrition are key fundamentals to military capability and historical examples demonstrated that a failure to supply adequate nutrition to armies inevitably leads to a disaster (Shchukina et al., 2018). Additionally, eating enough food to meet nutritional needs and maintaining good health & performance in all aspects of life is important throughout our lives. For military personnel, however, this presents a special challenge. Also, good health and peak physical fitness are key to military community readiness which can built strong stamina via eating nutritious foods that will provide energy and nutrients to human in order to perform best (Glushkov & Simeonov, 2019). The main ration provided to servicemen is mostly defined and is specific in Pakistan however, it is not specific considering geographical locations and physical activity. Also, ration items provided to the soldiers is not defined and modified considering current needs and deployment of servicemen. Therefore, present study which is first of its kind as per our knowledge to was carried out to estimate nutritional composition of existing ration items provided to servicemen and suggest changes in the menu as per nutritional needs and changing environment.

The current ration scale of servicemen indicated that each serviceman issued/provided whole wheat flour (700 g), white sugar (70 g), refined Oil/ghee (100 g), Pulses (90 g), whole milk Powder (50 g), Tea as 9 g, Rice as 453 g, Mutton is 226 g, Beef is 226 g, Chicken is 162 g, Eggs is 2 per week, vegetables is 198 g, Potato is 113 g, onion is 56 g, Fruit is 113 g and Salt is 9 g per person per day. The rice provided twice in a week but here it is divided on monthly basis to calculate the single daily value. Similarly, the beef or mutton is provided 5 days in a week with quantity similar and chicken is provided on two days in a week. Also, the fresh milk is not the part of the servicemen diet as well as fish is also not in the menu so there is need for the including of fresh milk, fish as well as reduce carbohydrates and fats in the menu.

The caloric value of MRE pack needs to be looked into, especially high energy carbohydrates have to be increased in MRE pack as they are used in high demanding operations that require soldier to be full of energy and strength. Complex healthy carbohydrates be added as a source of energy and quantity of traditional dishes be increased to make it wholesome as well as healthier (Kourkouta et al., 2017). Total calories need to be increased as ranged from 4181-4294 with highest being on red meat day and lowest on white meat with average being 4237.5 calories. Caloric loss occurs in cook house, due to different methods of cooking and cutting food items, influenced by tradition and troops likings/disliking. Various observations and studies, lead to the conclusion that this loss is 6-8% (Khalid et al., 2019; Pellegrini & Fogliano, 2017; Roncero-Ramos et al., 2017).

Also, considering the nutritional needs and physical deployment, it has been proposed to the existing ration items be replaced with whole wheat flour as 600 g, white refined sugar as 30 g, refined Oil/ghee as 80 g, pulses as 140 g, whole milk powder as 40 g & fresh milk Fresh as 240 mL, tea as 9 g, rice as 440 g, mutton as 130 g, Beef 130 g, Chicken as 162 g, Fish 170 g, Eggs as 1 on alternate days basis, vegetables Fresh as 150 g, fresh potato as 140 g, fresh onion as 60 g, fresh fruit as 160 g, biscuit pack or (crackers mostly non sweet) as 4 pieces having 60 g on alternate day and salt as 5 g per servicemen per day. The mutton and beef can be provided for 10 days out a month, 10 days for chicken and 10 days for fish. Also, the fresh milk is introduced considering the availability especially in the plains as well as the eggs should be added on the alternate days to meet the nutritional needs of the servicemen (Table 6).

The percentage of macronutrients in suggested menu carbohydrates as 68%, Fats as 17.56% and Proteins as 14.5%.

Table 6. Suggested ration scale for military personnel considered dietary requirements and health benefits.

No	Food Items	Existing Scale (g)	Suggested Scale (g)	Calories/day
1.	Whole wheat flour	700	600	2120
2.	Sugar (Refined)	70	30	220
3.	Oil (Refined)	100	80	720
4.	Pulses	90	140	258
5.	Milk Powder (whole)	50	40	210
6.	Milk Fresh	Nil	240 (mL)	80
7.	Tea	9	9	Nil
8.	Rice	453	440	43
9.	Mutton+	226	130 g/person for 10 days in a month	152
10.	Beef*	226	130 g/person for 10 days in a month	152
11.	Chicken	162	162 g/person for 10 days in a month	140
12.	Fish**	Nil	170 g/per person for 10 days in a month	28.5
13.	Eggs/ week	2	3.5	81
14.	Vegetables Fresh	198	150	31.5
15.	Potato Fresh	113	140	83
16.	Onion Fresh	56	60	26
17.	Fruit Fresh	113	160	230
18.	Biscuit Pack (crackers – Non sweet)	Nil	4 pieces having 60 g on (Alternate day)	40
19.	Salt	9	5	Nil

*In lieu is based on the availability for mutton and beef and it is provided on 5 days/week that need to reduce for 10 days in a week; **The fish is not the part of the menu so considering the health benefits, it needs to be incorporated and should be replaced with beef or mutton.

Also, nutrition awareness education of servicemen is one of the important aspects which is quite often missed as it improves the quality of life of servicemen (Cole et al., 2018). Most of soldiers come from rural background and have their likings/disliking based on family and peer preferences that can be changed considering the importance of food and nutrition through lectures and seminars. In case of troops who are acclimatized to extreme cold environment and have proper clothing to keep them warm, no extra special diet required unless they shiver and during physical activity like walking in snow and carrying heavy weight on back, necessitates about 8-15% extra energy (Caszo et al., 2019).

It is already established from literature that in cold environment, the main fuel of body is recommended to be protein and the effect of altitude pose greater emphases on carbohydrate stores thus bigger share for proteins recommended to be included in daily menu (Haman & Blondin, 2017). Since sweat in these climates is negligible, the hydration status should be well maintained even with lower than usual fluid intake and 2500-3000 mL is considered adequate. In hot and humid climatic areas, the most important factor is the maintenance of optimal hydration status. During active physical work in the open area, amount of water loss through sweating could be up to 1 L/hour, but usually in hot climate, the activities planned as to avoid working and physical exertion in direct sunlight as much as possible (Yerzhanova et al., 2018). Adding of extra sodium in drinking water or in diet also helps in the retention of water by body and balancing the loss of electrolytes in the sweat. A scale of 9 g/day instead of 5 gm/day of table salt suggested for troops in hot /desert areas. Usually, the carbohydrates are preferred for energy in hot environment but for long standing active operations proteins are needed for building the body stores and strength, so changes in menu can be made according to the requirement of the physical activity level and deployment area of the servicemen.

4 Conclusion

The findings of current study indicates that present ration scale for servicemen both in plains and higher altitudes are adequate considering nutrient density of different items in ration whereas, the ration scale for servicemen at plains altitudes (< 9000 ft) is more in terms of calories and nutrient contents. Considering the nutritional needs for servicemen at high altitudes, needs to be adjusted both in terms of calories and contents as total calories are higher as well as quantity of proteins and fats be increased and carbohydrates should be reduced. Also, healthy food items like fish, fresh fruits and vegetables, fresh milk and dried fruits may be added in the menu to meet the nutritional needs. The simple and refined sugars may be abolished in phases from menu as well as replacement of vegetable ghee partial if not total with refined edible oils should be considered on top priority. In present scenario of proven health benefits of natural antioxidants, their consumption could be increased through inclusion of herbal-based products in the ration. Further, one of the important factors is the nutrition education of the servicemen as to motivate them to choose healthy food items and abandon unhealthy food choices and products.

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