

# Acceptability and consumption: a study on the perception of the operational rations of the Brazilian Army in the operational environment of jungle

*Aceptabilidad y consumo: estudio sobre la percepción de las raciones operativas del Ejército Brasileño en el ambiente operativo de la selva*

**Abstract:** Acceptability and consumption of operational rations are objects of study in several world armed forces, due to the frequent history of underconsumption. In this scope, the present work sought to identify, in an unprecedented way, the perception of military personnel about the menus in the operational environment of the jungle, a strategic region for national defense, through the association of data obtained through an electronic questionnaire and a qualitative instrument of focus groups. The results showed the perception of high technology, but showed opportunities for improvement in terms of monotony, nutritional profile and well-being in consumption. The focus groups emphasized demands for nutritional adaptations and increased menu variety. It was observed that a fraction of the menus present consumption lower than 75% of the volume offered, indicating the need for reformulations, aiming to mitigate underconsumption and impacts on operability. Therefore, it is suggested that complementary studies be carried out, providing opportunities for the development of products that are more adapted to the strategic environment of the jungle.

**Keywords:** focus group; nutritional profile; monotony; variety.

**Resumen:** La aceptabilidad y el consumo de raciones operativas son objeto de estudios en varias fuerzas armadas del mundo debido a la frecuente historia de bajo consumo. Dentro de este ámbito, este artículo buscó identificar, de forma inédita, la percepción del personal militar sobre los menús en el ambiente operacional de la selva, región estratégica para la defensa nacional, a través de la asociación de datos obtenidos por cuestionario electrónico e instrumento cualitativo de grupos focales. Los resultados mostraron la percepción de alta tecnología, pero destacaron las oportunidades de mejora en términos de monotonía, perfil nutricional y bienestar en el consumo. Los grupos de discusión destacaron las demandas de adaptaciones nutricionales y mayor variedad de menús. Se observó que una fracción de los menús presenta consumo inferior al 75% del volumen ofrecido, indicando la necesidad de reformulaciones, a fin de mitigar el bajo consumo y los impactos en la operatividad. Así, se sugiere la realización de nuevos estudios, proporcionando oportunidades para el desarrollo de productos mejor adaptados al ambiente estratégico de la selva.

**Palabras clave:** grupo de discusión; perfil nutricional; monotonía; variedad.

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## 1 INTRODUCTION

Military work demands high energy expenditures during varied training, such as personnel employment on border strips, engineering missions, actions coordinated with government agencies, and refugee protection, among others. Therefore, appropriate food sources, including operational rations, represent one of the most important conditions for maintaining these professionals' physical and mental health (BOTELHO *et al.*, 2014).

With the publication of the Armed Forces Food Manual (MD42-M-03), through Normative Ordinance No. 219/MD, dated February 12, 2010, the Armed Forces now have, in accordance with standardized guidelines, access to safe, balanced, and adequate food for the different operational situations inherent to military life, and it was considered, from that time, a security matter by the Brazilian Armed Forces Food Commission (BRASIL, 2010; SILVA, 2015).

The activities carried out daily in the exercise of the military function are closely dependent on the physical, social, and mental state, hence the importance of food factor, not only in relation to satisfaction with eating, but also in relation to the conditions of elaboration of the food produced within food safety standards. The economic context in which Brazil is inserted demands operability at the lowest cost possible for the country's survival, and the search for lower logistical costs meets the Brazilian society's aspirations (SILVA, 2015).

Military forces often operate far from supply bases and have to be prepared to operate in extreme environments, which can be ultra-cold and low-pressure locations, cold at high altitude, or jungle environment. Food format and nutritional composition should also be varied to meet the military's specific needs and activities in these environments, while preserving food and nutritional quality (STANLEY; FORBES-EWAN; MCLAUGHLIN, 2019).

When these soldiers are on missions or training in hostile environments, such as the jungle biome, energy expenditure may increase, which may impair troop performance. Therefore, to ensure good performance in these activities, it is necessary to have a diet with sufficient energy demand to meet different basal nutritional needs and additional psychological stress (BOTELHO *et al.*, 2014; CARVALHO *et al.*, 2019; MILLET *et al.*, 2021).

The determination of energy requirements is, therefore, based on intrinsic factors, such as the soldier's physical state, and also extrinsic ones, such as different types of maneuvers or environmental elements. Demanding military missions often involve activities that lead to lack of sleep and long alertness periods. Thus, providing adequate nutrition is extremely relevant to mitigate stressors and favor physical, cognitive, and immune performance (TASSONE; BAKER, 2017).

In this context, Brazil has continental dimensions, with a territory that covers different geographic regions and operational environments, from the *pampas* of the extreme South to the Amazon region biome, characterized by high electrolyte depletion and a demand for

foods with better digestibility. The different Brazilian Armed Forces have autonomy to outline their technical employment demands, developing products that are more adequate to their strategic objectives.

Thus, the Brazilian Army's combat operational ration (R2) was designed to keep a soldier in operations for a 24-hour period, consisting of a set of main basic foods (thermoprocessed meals in retort pouch packaging, in this case, lunch and dinner), complementary food items (cassava flour, coffee, chocolate milk, sugar, hydroelectrolytes replenisher and snacks, among others), and accessories for cooking, such as stoves and cutlery, which are provided when it is impossible to deploy a field kitchen, and should have a good acceptability by the supported troop (BRASIL, 2022).

The concern with acceptability is not recent and is not only related to the development of new food technologies. Scientifically, it began during World War II, when balanced diets developed by nutritionists had a very low level of acceptability by soldiers. It was in this context that the American Armed Forces began to finance studies with the aim of improving the sensory quality of meals offered to the Army (MINIM, 2006).

When the soldier stops consuming their nutritional and caloric demands effectively, impacts such as weight and basic nutrients losses can interfere with their health and activity maintenance, which is a vulnerability for the deployment of an operation (AHMED *et al.*, 2019). Existing historical and experimental data indicate that decreases in physical performance begin in individuals when 10% or more of initial weight is lost (THARION *et al.*, 2004).

Thus, research should be continuously developed to map a food type that will better meet demands of a soldier who, in theory, is exposed to extreme stress conditions, seeking in food a way of comfort that can be provided with the help of a safe and palatable meal, reinforcing the food restorative role. Still in this scope, when the operational ration components are not completely consumed, a financial waste is inferred, since the products have a high added value and their acquisitions are expensive for the government.

Therefore, it is important to investigate the consumption profile of operational rations in the Amazon jungle environment, a nationally strategic region, contemplating approximately 22,000 soldiers, and submitted to different profiles of operations, with high consumption of operational rations. Due to the lack of studies in this area, the methodology, at the limit, covered the application of electronic data collection combined with the qualitative focus group technique, allowing also the military's free expression of opinions, therefore bringing reliable results.

The focus group technique was chosen because it is one of the main qualitative tools used to develop the preliminary stages of a piece of research, based on group dynamics whose objective is to stimulate discussion through the exchange of opinions among the participants, enabling the approach of different themes and ideas (WRIGHT, 2015; ELDESOUKY; MESÍAS, 2014; ESMERINO, 2017).

In view of this, this article intends to identify the military's perception of menus in an operational jungle environment, with the help of the association of data obtained through an electronic questionnaire and focus groups, a qualitative instrument, in order to investigate general impressions, consumption and acceptability, and, then, open gaps to propose studies aimed at possible reformulations of existing operational ration menus in the search for food types more adapted to the demands of activities and operations deployed in the Amazon biome.

## 2 MATERIAL AND METHODS

### 2.1 Participants

This study was carried out between July and September 2020, in a Military Organization of the Brazilian Army located in the Amazon region, and the participation criteria were being a professional military man and having completed the Jungle Operations Course (COS). The total group of participants consisted of 162 soldiers, aged 24 and 32 years, all male, with an average age of 27 years old. As to the school level, 66% had secondary education, while 34% had tertiary education, and in relation to graduations and ranks, 62% participants were privates and 38% were officers. Most of the participants (59%) came from the Southeast region and the others from the South (19%), Northeast (14%), and North (8%) regions, respectively. There were no participants from the Central-West region.

The research was approved by the Ethics and Research Committee of UFAM (Universidade Federal do Amazonas) under number CAAE 53496121.1.0000.5020.

### 2.2 Online Survey

After authorization from the Command of the Military Organization, an electronic questionnaire was prepared and made available to the participants on Google Forms platform, aimed at investigating topics in three main themes:

(i) general impressions about menus in the jungle, with answers on a 9-point Likert Scale (1 – totally disagree; 9 – totally agree) (DALMORO; VIEIRA, 2017). The variables in Chart 1 were analyzed;

(ii) acceptability of menu items, with responses on a 9-point hedonic scale (1 – dislike extremely; 9 – like extremely), presented to participants in a balanced complete block design (DALMORO; VIEIRA, 2017);

(iii) consumption of menu items, with responses in five options (0%, 25%, 50%, 75 % and 100%), representing the approximate intake projection of each menu, according to the form developed by the US Army at Natick Center Soldier Center (FOX; WENKAM; HIRSCH, 1988) and associated countries of the North Atlantic Treaty Organization (NORTH ATLANTIC TREATY ORGANIZATION, 2019).

**Chart 1 – Variables analyzed on the Brazilian Army soldiers’ general impressions about the menus available in the jungle environment**

Questions	Description
1. The existing menus in the Brazilian Army are adapted to the jungle environment.	The physiological and nutritional impacts, interfering with performance and operability, may vary based on varied consumption profiles, depending on each region where the personnel have the intake.
2. Menu options are sufficient for jungle operations.	The military are directed to make impressions about the amount of menus offered during operations.
3. I manage to consume the menu options in longer jungle operations without causing a feeling of monotony.	The monotony aspect is related to the impact of repeating menus in situations of prolonged consumption.
4. I notice the feeling of well-being when consuming menus in the jungle environment.	The feeling of well-being is closely related to pleasure in consumption, as well as to impacts on troop morale.

Source: Elaborated by authors, 2022.

### 2.3 Focus Group

Four Focus Groups were conducted, with the presence of ten military men in each session, totaling 40 participants. The military in the focus groups were selected from a random, non-probabilistic convenience sample, according to interest and availability to participate in the study. The age group was between 24 and 31 years old, with an average age of 26 years old. As to schooling, 72% had secondary education and 28% had tertiary education. The majority (60%) was represented by privates, and 40% by officers.

The total number of sessions was established by the moderator, after the saturation point had been reached. Data saturation is reached when there is information to replicate the study (FUSCH; NESS, 2015), that is, when the ability to obtain additional new information is no longer feasible (GUEST; BUNCE; JOHNSON, 2006). Each session lasted one hour on average, supervised by a moderator and an assistant. In this way, the most significant impressions about general attributes were collected, such as packaging, variety and menu components, ease of preparation, satiety, digestibility, well-being, and waste disposal and quality, following a script of pre-established questions, present in Chart 2, however deepened as needed. The military were given instructions about no right or wrong ideas, and were encouraged to express their opinions freely (ELDESOUKY; MESÍAS, 2014).

The sessions were recorded after participants’ authorization and held in an appropriate room, free of external distractions. Data were analyzed by the main researcher after transcription of the recorded files, according to the topics covered.

Chart 2 – Thematic areas and verbal comments of participants from Focus Groups

Themes/Questions	Verbal Comments
<b>1. Are the quality and quantity of operational ration menus satisfactory?</b>	<p>“I think the quantity of menus is good, but they could be a little more tasty” (29 years old, FG* I);</p> <p>“There is little variety in the menus offered” (25 years old, FG III);</p> <p>“I consider it a safe product with good technological quality” (24 years old, FG II).</p>
<b>2. Do you consider the menus suitable for all operational environments? From low mountain temperatures to jungle weather conditions?</b>	<p>“The menus in the Amazon region could have more highly digestible proteins, facilitating jungle operations, fish, for example” (29 years old, FG I);</p> <p>“I experience more digestive difficulties in hot and humid environments, with a lot of intestinal discomfort, interfering negatively with operability” (31 years old, FG III);</p> <p>“Menus are very tasty, I think they are perfectly adapted” (28 years old, FG II).</p>
<b>4. In the case of a longer consumption, would the food still be attractive, that is, is there a perception of fatigue due to the menu monotony?</b>	<p>“I don’t see any problems in extending consumption, because I see good quality in general” (28 years old, FG I);</p> <p>“When it’s possible, we take supplements, such as straw potatoes, cereal bars and even condensed milk, to improve consumption” (27 years old, FG IV).</p>
<b>5. Is there full component consumption?</b>	<p>“Some items have a good flavor, such as chicken stroganoff, which is well consumed by the majority; rice, for example, is dry, tasteless, and waste is high” (28 years old, FG II);</p> <p>“I open the general packaging and select only the items of interest to me” (27 years old, FG IV);</p> <p>“I don’t think I consume 100% of all content, just the items I like the most” (30 years old, FG I).</p>
<b>6. Is there a feeling of pleasure, stress reduction and socialization? Does it generate well-being?</b>	<p>“Some items, such as chicken and beef stroganoff, generate a good feeling, well-being and satiety” (24 years old, FG IV);</p> <p>“I end up repeating the items with the best taste, which is fine for me” (26 years old, FG II);</p> <p>“Items with more carbohydrates, sweeter, give us a lot of pleasure too, but some products should be improved, such as rice, which is dry” (29 years old, FG III);</p>
<b>7. What is the consideration on a possible development of protein pack, and energy?</b>	<p>“It would be awesome to have an alternative to help in situations of fatigue” (24 years old, FG III);</p> <p>“It would be a good option; whenever I can, I take BCAAs and carbo gel” (27 years old, FG IV);</p> <p>“I believe that operability would improve, even with products containing caffeine” (25 years old, FG I).</p>
<b>8. Do you have the impression about being supplied by food? In the proposed interval, for each feeding stage, is there a feeling of satiety?</b>	<p>“Yes, for example, the stroganoffs is very good” (31 years old, FG I);</p> <p>“I feel very hungry between breakfast and lunch” (24 years old, FG III);</p> <p>“Breakfast is too early, and items like crackers don’t last until lunch” (25 years old, FG IV).</p>
<b>9. Would you like to propose changes to the menus? Which changes?</b>	<p>“Inclusion of more baked goods, pasta and pizza” (25 years old, FG II);</p> <p>“Increase in the amount of hydroelectrolytes replenishers” (28 years old, FG III);</p> <p>“Inclusion of more fiber in the diet, a lot of constipation [occurs] and poor digestibility (29 years old, FG IV);</p> <p>“I would like more fish and chicken products” (28 years old, FG I);</p>

continue

**Chart 2 – Continuation**

Themes/Questions	Verbal Comments
<b>10. Is the packaging of adequate volume and easy to handle? Does a tired and exhausted person accept instructions correctly?</b>	“The packaging is easy to handle, but the volume does not help” (27 years old, FG I); “We open the packages beforehand and select the items, we don’t even take what will not be consumed to relieve weight and volume” (28 years old, FG IV); “Simple instructions and easy handling” (24 years old, FG III); “Vacuum packaging would help a lot in reducing volume” (30 years old, FG I).
<b>11. Do you consider packaging environmentally appropriate?</b>	“No, but I think it’s an important topic” (28 years old, FG III); “The packaging could be biodegradable, causing less environmental impact” (28 years old, FG I).
<b>12. Can you infer benefits from research in this area?</b>	“Yes, because I consider it fundamental that the end of the line be heard” (28 years old, FG III). “It is very important to improve the menu quality and variety” (27 years old, FG II); “The menus do not necessarily need to be regionalized. Simple optimization can be advantageous, such as replacing low-consumption items” (25 years old, FG I).

Note: \*Focus Group

Source: Elaborated by authors, 2022.

## 2.4 Data Analysis

The questionnaire answers on general impressions and acceptability were analyzed based on descriptive interpretation and frequency, with the support of the R Project for Statistical Computing software. A central median axis of answers was identified and categorized by neutrality. The other results were positioned according to acceptability bias, positive or negative. Data interpretation based on the graphic representation makes it possible to measure the intensity degree of positive or negative answers.

Consumption responses were interpreted by frequency analysis, using Microsoft Excel Spreadsheet software, in order to facilitate the consolidation and objective interpretation of data on consumption in the jungle environment operations. The results were expressed in two main Groups: the first one, contemplating consumption greater than or equal to 75%; the second one, with consumption below 75% (NORTH ATLANTIC TREATY ORGANIZATION, 2010).

With regard to the Focus Groups, the collected data, due to the qualitative nature of the research, did not undergo specific statistical treatments, only a thematic organization of ideas that seek the objective expression of the impressions about a certain group on the subject under analysis (VIEIRA *et al.*, 2013).

## 3 RESULTS AND DISCUSSION

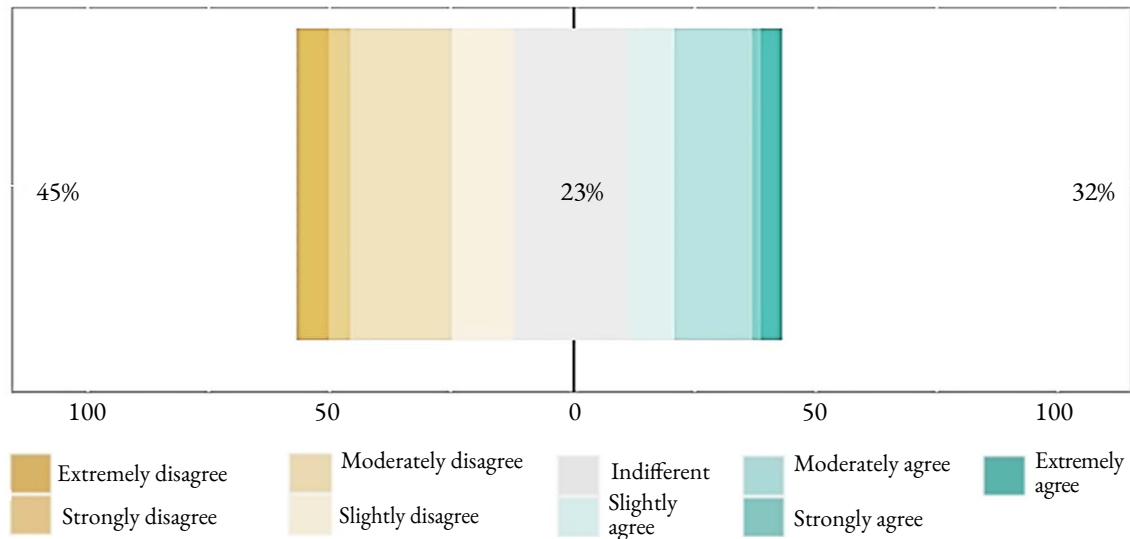
### 3.1 Online Questionnaire

#### 3.1.1 Adaptation of Menus to the Jungle Environment

Regarding the adaptation of menus to the jungle environment, characterized mainly by high temperatures and high humidity, 45% participants consider that these are not adapted,

and 32% consider them suitable for the jungle environment; however, there is a range of neutrality of approximately 23%, as shown in Figure 1. Thus, it is noted that almost half of the respondents considers this item as a sensitive point for feeding the military on mission in this type of environment.

**Figure 1 – Adaptation of operational ration menus to the jungle environment**



Source: Elaborated by authors, 2022.

The hot and humid jungle environment already demands a nutritional profile with proteins of better digestibility, reducing the intake postprandial effects, since the military do not have a pre-established rest period, that is, they always have to stay alert. Seeking a nutritional adaptation, the rations used for hot and humid climates should advocate the following adaptations: provide additional energy and contain components less susceptible to degradation by heat; emphasize complex carbohydrates, with adequate protein and moderate fat, and provide additional dry drink mixes to increase fluid intake and help reduce the risk of dehydration due to excessive sweating and consequent loss of body fluids (NORTH ATLANTIC TREATY ORGANIZATION, 2019).

As a result of low adaptation to the environment, a possible underconsumption can be observed, impacting on the body and cognitive score. According to the US Committee on Military Nutrition Research, a gradual loss of body weight between 3% and 10% during military training lasting three to 30 days is unlikely to affect performance, but, a rapid loss of 6.2% weight over a one-week period will lead to worse cognitive outcomes including more tension, depression, anger, fatigue and confusion (TASSONE; BAKER, 2017).

The reduction in menu intake is probably the final result of a combination of factors that include appetite suppression and palatability/variety of feed provided, which is aggravated

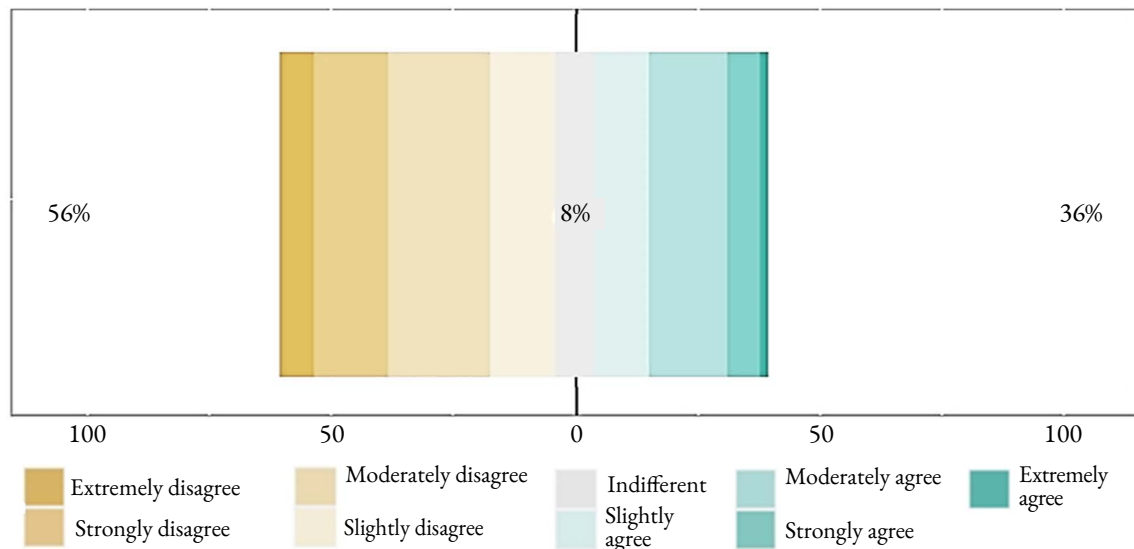


in situations of extreme stress, as in the Amazon biome (FALLOWFIELD *et al.*, 2014; JOHNSON *et al.*, 2018). In this sense, there is need for improvements that provide more stimuli for ingestion, such as greater food variety, and better palatability and digestibility.

### 3.1.2 Nutritional Profile in Longer Jungle Environment Operation

It was found that, for 56% military, the rations would not provide energy, proteins, nor macro and micronutrients needed for a longer-lasting activity, impacting the activity operationalization, with possible direct effects on individual performance, as shown in Figure 2:

**Figure 2 – Nutritional profile in longer operations**



Source: Elaborated by authors, 2022.

However, there is a relevant aspect to be mentioned: the current feeding doctrine does not foresee the use of rations for more than three days. The current menus are doctrinally recommended to maintain health and body score in operational conditions in missions of up to, and only, three days, from preparation activities – such as varied training aimed at combatant qualification – to real employment situations – such as deployments of peacekeeping missions or operations in hostile environments, as the Amazon jungle (BRASIL, 2022).

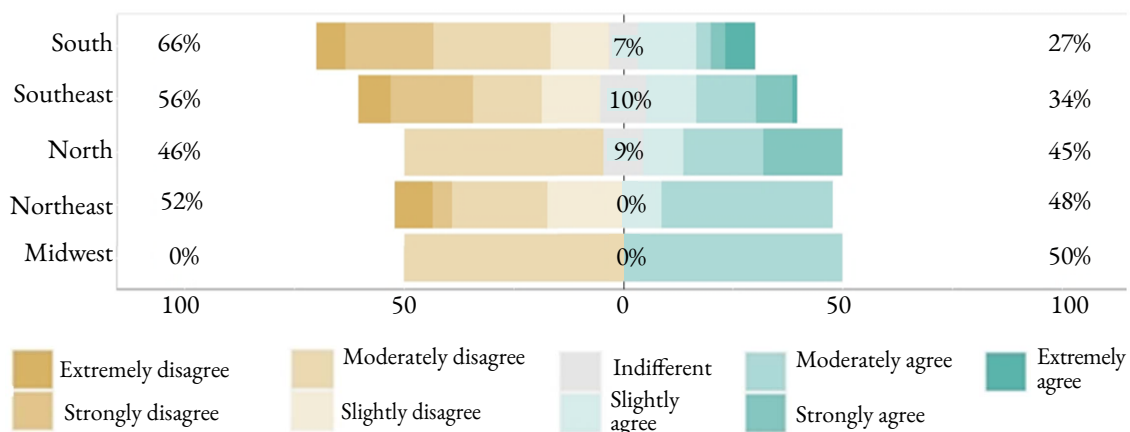
It exposes the relevance of showing that this three-day period was defined by Ordinance nº 721, of December 30, 1999, just citing aspects of monotony and without a technical or physiological basis, besides having been elaborated more than 20 years ago in a logistical and operational context divergent from the current one (BRASIL, 1999).

Military missions have a highly imprecise and variable time of employment, with a tendency to prolonged operation periods. As an illustration, in the North Atlantic Treaty Organization (NORTH ATLANTIC TREATY ORGANIZATION, 2010), the nutritional recommendations allow that the combat ration be used exclusively for a maximum 30-day period, and there may be emergencies in which the military will be obliged to subsist on the ration for a longer duration, until fresh food can be provided.

In the United States Army, the military food policy allows combatants to consume three meals of operational rations for up to 21 consecutive days as their sole source of sustenance (MCCLUNG *et al.*, 2020).

Still, 36% military consider that the current rations can supply the combatant in longer periods, maintaining the body score and the adequate nutrient delivery, that is, guaranteeing the macro and micro nutritional balance necessary for their homeostatic maintenance. In order to analyze this population group's profile, answers were also evaluated according to each military man's region of origin, seeking impressions by geographic region, thus obtaining Figure 3:

Figure 3 – Nutritional profile in prolonged operations x military man's region



Source: Elaborated by authors, 2022.

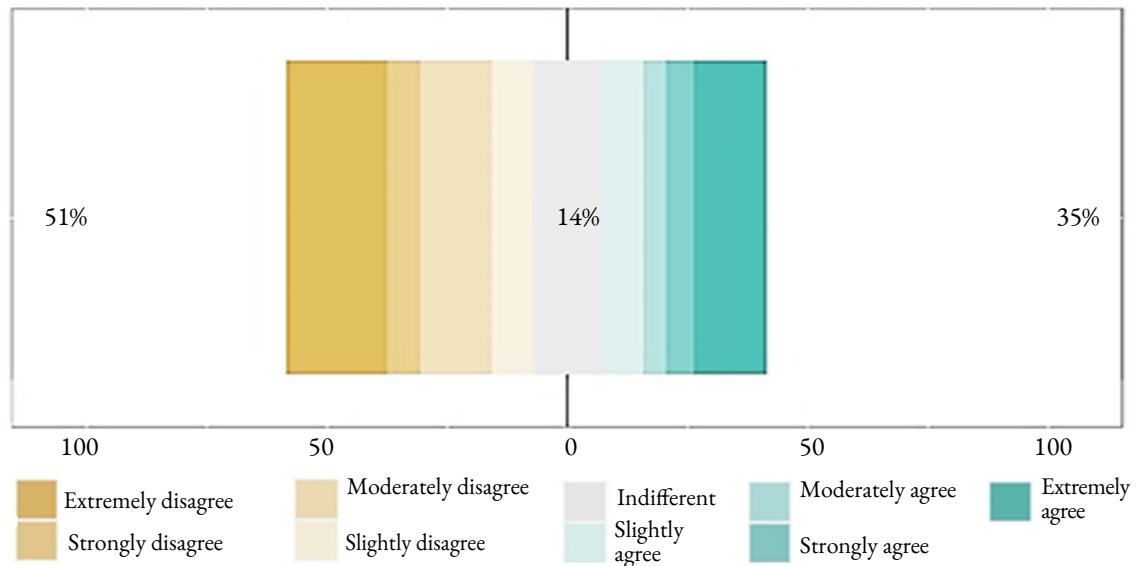
Military men from the Southeast and South regions have a more demanding consumption profile, in which 66% and 56%, respectively, considered the menus adequate for longer-term employment. These characteristics may be in accordance with the profile of the Gross Domestic Product (GDP) of these regions, respectively first and second in Brazil, leading to greater product diversity and, thus, forming a profile of more selective consumers (RESENDE; MAGALHÃES, 2013). Regarding the participants from the North and Northeast regions, 52% and 46% considered the menus unsuitable, respectively.

### 3.1.3 Menu Monotony in the Operational Jungle Environment

Thermoprocessed foods sterilized in an autoclave form the basis of the operational ration meals (lunch and dinner) and are packaged in long-lasting flexible laminated packaging (retort pouch), without the need for refrigeration, and are represented by chicken stroganoff, beef stroganoff, chopped beef in sauce, beef with goulash sauce, *vaca atolada* (beef ribs with cassava), beef with vegetables, *feijoada*, minced beef with potatoes, pinto beans with sausage, rice with beans and beef. Cassava flour, which does not undergo thermal processing, was also included in this analysis because it is part of the menu options.

It was observed that 51% military consider the menus monotonous, with little variety, not meeting individual demands in possible situations of longer operations, which infers a worrying negative impact on consumption due to the loss of attractiveness and food fatigue. Such a situation can interfere with individual performance due to the nutrient underconsumption that would mitigate the combatant’s physical and psychological exhaustion (AHMED, 2019). It should be noted that 35% consider the quantity of menus to be satisfactory, with 14% having a neutral range, forming a balance profile, as shown in Figure 4:

Figure 4 – Menu monotony in the jungle environment



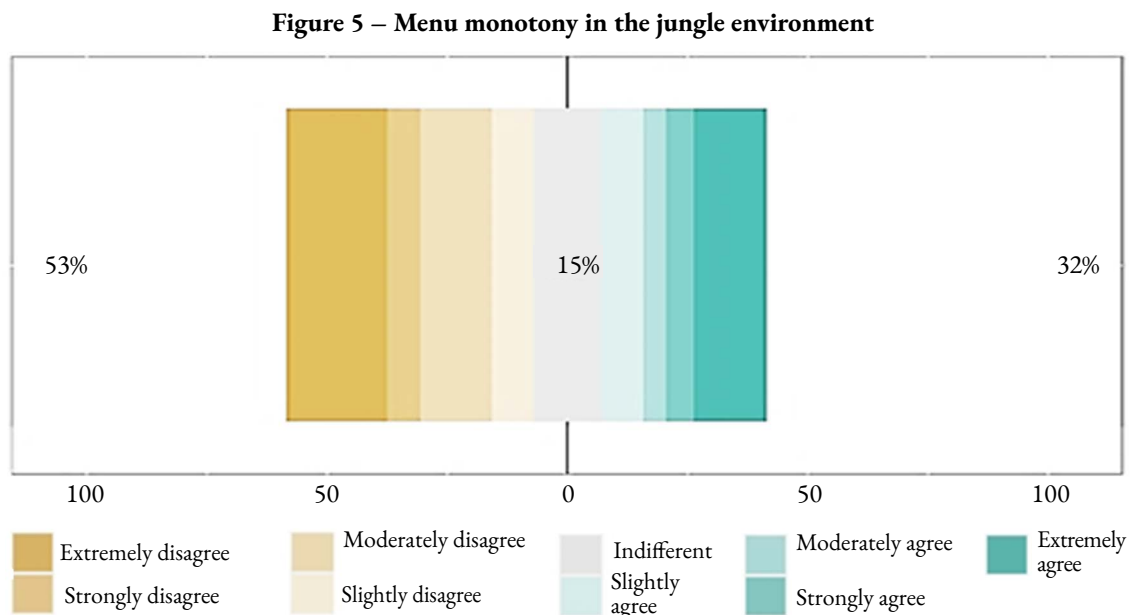
Source: Elaborated by authors, 2022.

The monotony may be directly related to the quantity of existing menus, but the consolidation of a larger amount and in a rotation system could help improve this aspect. As an example, among NATO member countries, menu options vary from two units (Czech Republic) to 24 items (United States), covering the main meals, given the general requirement to provide a varied diet to combatants that encourages its consumption (NORTH ATLANTIC TREATY ORGANIZATION, 2010).

Crawford (2020) observed, in a study with Canadian rations, that boredom is worrying and refers to the inevitable monotony of eating the same food for a long period. Logistical and resource challenges make it difficult an unlimited rotation of menu items, however maintaining a reasonable variety of menu items is important to reduce menu monotony and fatigue. To avoid boredom, the Canadian Army currently supports a rotation of approximately 20 different main menu items per year, which may be a plausible strategy to implement nationwide.

### 3.1.4 Well-being in the Operational Jungle Environment

As shown in Figure 5, for 53% military, ration menus do not provide well-being, that is, they do not provide that feeling of pleasure in consumption, in addition to some psychological comfort. Only 32% perceive positive wellness effects from eating. In operations, food should work as an element that raises the combatant's morale and reduces stress, an extreme factor.



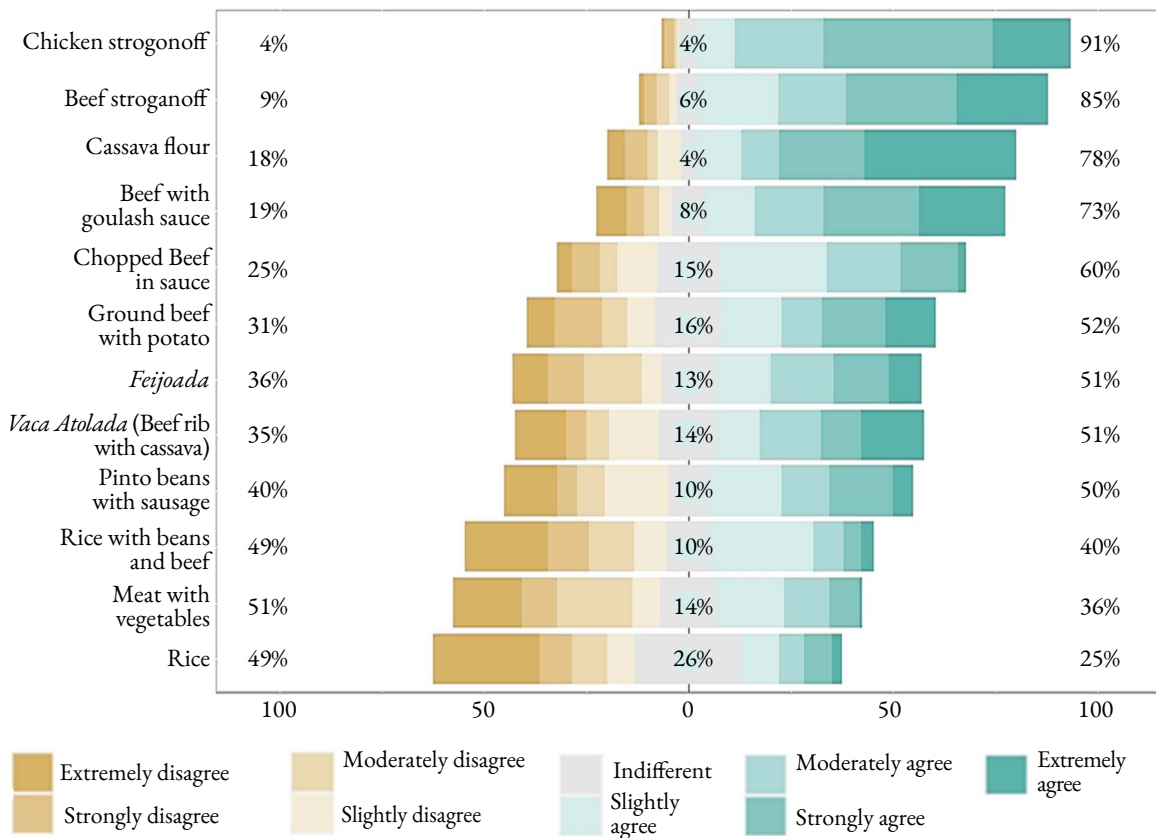
Source: Elaborated by authors, 2022.

There are few variables to mitigate operational stress, sometimes configured by exhaustive actions with few hours of rest and at inappropriate places. A diet that provides comfort and well-being can mitigate individual stress, impacting performance positively. Thus, food, in addition to the primary function of nutritional and physiological support, has to provide a feeling of comfort and pleasure in its ingestion, particularly in real military operations (SPENCE, 2017). The perception of food discomfort can compromise intake and potentially determine a serious weight loss, which will lead to a reduction in operational performance (HIRSCH *et al.*, 2005).

### 3.1.5 Acceptability of Staple Food in the Operational Jungle Environment

In evaluating the acceptability of the operational rations, based on previous experimentation of the items, it was observed that the most accepted menus were the beef and chicken stroganoff, with respectively 91% and 85% positive evaluations. However, on the other hand, beef with vegetables and rice had low acceptability, 36% and 25%, respectively, as shown in Figure 6. Also noteworthy is the high acceptability of the cassava flour, 78%, a product that has little added technology, however, with high consumption throughout the national territory and an excellent source of carbohydrates.

Figure 6 – Acceptability of Staple Food in the Operational Jungle Environment



Source: Elaborated by authors, 2022.

Thus, of the 12 analyzed menus, only three formulations (rice with beans and beef; beef with vegetables; and rice – 25%) presented results with levels below 50% of acceptability. The results obtained raise an alert regarding the sensory quality of the products offered and suggest that, given the evaluated acceptability, there may be an underconsumption of these menus by the military.

Perceptions of the existence of a low sensory acceptance and underconsumption profile in Brazilian operational rations have already been reported. According to researchers Campos and Marques:

In all evaluated sensory attributes, the results obtained were considered undesirable. Complementary research should be carried out in a controlled environment, with specialized troops, to assess whether the complexity of the theater of operations interferes with the situation and eating behavior of the combatant. (CAMPOS; MARQUES, 2020, p. 13)

According to De Graaf *et al.* (2005), little research on the acceptability of combat rations has been performed, showing the importance of studies that demonstrate the military's real needs in the most divergent profiles of operational environments, optimizing physical and cognitive health.

In the United States, the use of the 9-point hedonic scale (1 – dislike extremely and 9 – like extremely) to assess acceptability, developed by the US Army in the 1950s, is widely disseminated. Most commercial food products intended for the general public average between five and eight (NORTH ATLANTIC TREATY ORGANIZATION, 2010). Based on this methodology, the results obtained can be seen in Table 1:

**Table 1 – Acceptability mean and standard deviation of menus in the jungle environment**

Menu	Mean	Standard Deviation
Chicken stroganoff	7.4	1.5
Beef stroganoff	7.0	1.9
Cassava flour	7.0	2.4
Beef with goulash sauce	6.5	2.4
Chopped beef in sauce	5.6	1.9
Minced beef with potatoes	5.5	2.5
<i>Vaca Atolada</i> (beef ribs with cassava)	5.5	2.6
<i>Feijoada</i>	5.2	2.5
Pinto beans with sausage	5.1	2.4
Beef with vegetables	4.3	2.3
Rice with beans and beef	4.2	2.4
Rice	4.0	2.4

Source: Elaborated by authors, 2022.

In this context, three menus (beef with vegetables, rice with beans and beef, and rice) also would not potentially be commercially acceptable, corresponding to 25% analyzed items. Also, the results of low acceptability of the items rice, rice with beans and beef, and beef with vegetables, with scores below five points, give rise to a concern with possible impacts on consumption according to a study carried out by De Graaf *et al.* (2005), who observed that the

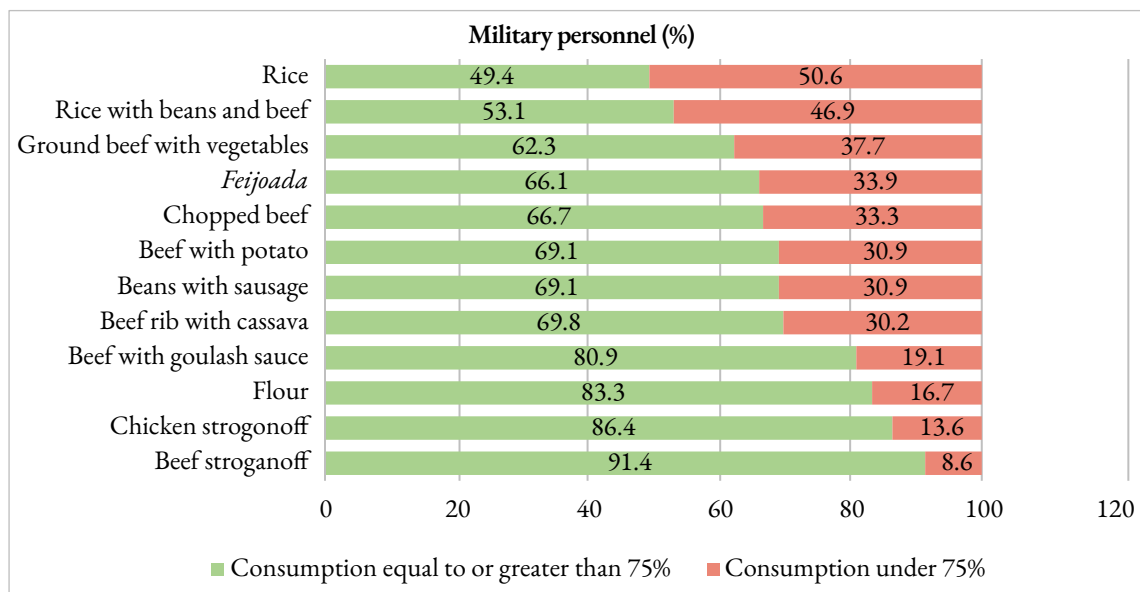
consumption of portions of items with scores below 5 points in the acceptability criterion was below 77% total amount. Thus, there is an additional concern regarding the item rice, since it constitutes the main source of carbohydrates in the diet and is present in all the menu options offered, causing impacts on the balance of calories ingested, which becomes an aggravating factor in high-demand jungle environment.

The Brazilian territory has continental dimensions and diverse biomes and native populations, with regionalized food profiles. Certainly, the Amazon region’s impressions may differ from others, but they have to be scientifically based for menu optimization, aiming at increasing consumption, reducing material losses, and mitigating physical, cognitive, and performance deficits.

### 3.1.6 Acceptability of Staple Food in the Operational Jungle Environment

Of the 12 basic food menu items, two (12.5%) of these (rice with beans and beef; rice) presented consumption below 75% offered portion, by approximately 50% participants, causing a concern about possible impacts on the consumption and, consequently, on the body score. The results are shown in Figure 7:

**Figure 7 – Consumption of staple food operational ration in the operational jungle environment**



Source: Elaborated by authors, 2022.

Aligning with the good acceptability of beef and chicken stroganoff menus, 91% and 86% participants indicated their consumption equal to or greater than 75% offered portion, respectively. The same trend can be observed with cassava flour and beef with goulash sauce, both with good acceptance and consumption.

However, it was found that 51% participants reported rice consumption below 75% package volume. It is observed that under these circumstances, a caloric deficit of 260 kilocalories (Kcal) occurs according to the Brazilian Table of Food Composition, representing 8% total calories in a dietary demand of 2,800 Kcal indicated for an adult in normal conditions of activity, inferring an interference in the body score (BRASIL, 2010; UNIVERSIDADE DE CAMPINAS, 2011).

The results are in line with reports on inadequate calorie intake and possible impacts on energy deficits during intense periods of operations and field training, which can reach about 40% military's total energy needs (FALLOWFIELD *et al.*, 2014; MARGOLIS *et al.*, 2014; MARRIOTT; 1995).

Booth, Coad and Roberts (2003), in a study on the exclusive consumption of rations for a 23-day period in the Australian Army, observed that there was a high rate of discarding items, with foods rich in carbohydrates being the most discarded: on average 46% crackers, 72% mushroom bars, 81% baked beans, 93% chocolate, 94% white sugar, 96% candies, 99% potato powder and 100% rice – i.e., 40% energy available.

According to a randomized clinical trial carried out in the US Army, when rations are consumed as intended, for a 21-day period, soldiers are nutritionally adequate in terms of energy and micronutrients (LENFERNA DE LA MOTTE *et al.*, 2021; MCCLUNG *et al.*, 2020). Nevertheless, several studies report that rations are rarely consumed as should be (BOOTH; COAD; ROBERTS, 2003; FALLOWFIELD *et al.*, 2014; HILL *et al.*, 2011; MARGOLIS *et al.*, 2014; ZINN C *et al.*, 2017). Waste, underconsumption, and negative energy balance are commonly reported issues, resulting in weight loss, body fat reduction, protein catabolism, immune suppression, increased perceived fatigue, decreased military performance (reaction time, marksmanship, and decision making), increased risk of injury and decreased resistance (BEALS *et al.*, 2019; BOOTH; COAD; ROBERTS, 2003; HILL *et al.*, 2011; LENFERNA DE LA MOTTE *et al.*, 2021).

With regard to the item rice with beans and beef, consumption below 75% was registered in approximately 47% answers. This means that in a portion of 350 grams (g), at least 87g are not ingested by approximately half of the participants, representing a deficit of 203 Kcal, in addition to micronutrients such as vitamin C, B vitamins, iron, and calcium (UNIVERSIDADE DE CAMPINAS, 2011).

The protein genres are and additional concern: in addition to being a caloric source, proteins participate in complex metabolic activities in the body structure, especially in the health of the body score. For example, a 100g portion of *feijoada* contains 8.7g of protein, 6.5g of lipids, 32 milligrams (mg) of calcium and magnesium, 11g of fiber and 22mg of cholesterol, which participate in several metabolic processes, including the hormonal modulation and neuromuscular functioning (UNIVERSIDADE DE CAMPINAS, 2011).

Despite the results of this work demonstrating compatibility between acceptability and consumption, De Graaf *et al.* (2005) found that acceptability plays an important role in food intake and choice, but this is not the dominant factor at all. In this sense, one verifies that additional research on the factors that determine food intake by the military is necessary and



should analyze the interaction between mission, food, and the environment where the operation will be carried out.

### 3.2 Focus Groups

According to Gaspar, Escribano and Mesias (2016), the main advantage of using focus groups in relation to other more structured research methods, for example, questionnaires, is that this method allows promoting greater freedom of expression in the discussion of varied topics (CHALOFISKY, 2001; MESÍAS; MARTÍN; HERNÁNDEZ, 2021; STEWART; SHAMDASANI, 2014).

In this way, through discussions and debates in Focus Groups, the most significant impressions were collected about general attributes, such as packaging, variety and menu components, ease of preparation, satiety, digestibility and well-being and disposal of waste, as results expressed in Table 2, with the most relevant participants' comments.

Menus were a widely discussed subject, and they were considered monotonous by the military. Simpler diet solutions were presented, approaching homemade products with greater acceptance, such as grilled/roasted dishes, pasta, *carreteiro* rice, *tropeiro* beans, among others, which already occurs in other countries and which would improve the "well-being" component," favoring pleasure in consumption, as reported by a participant in the Focus Group (FG) II, who describes the desire to see "inclusion of more baked goods, pasta and pizza." Ideas regarding improving product options were also noted, rather than increasing the amount of food offered.

Another fact pointed out by practically everyone refers to satiety. Although breakfast was not the subject of this article, there were significant recurrent reports on the insufficiency of nutrients in this meal, with emphasis on the low caloric amount, as reported by a FG IV participant: "Breakfast is too early, and items like crackers don't last until lunch." Besides the nutritional gap between breakfast and lunch, it is still possible to infer the underconsumption of some basic foods already mentioned, which leads the military to seek alternatives to meet the demands, such as eating food in the environment or carrying personal items, such as assorted crackers or straw potatoes, which unbalances the profile of the food offered by the supply chain, modifying the institutionally proposed diet. It is essential to explain that the periods between meals are usually long and many military men, in a compensatory way, consume breakfast items fractionally, mitigating the feeling of hunger. Also with the same objective, they usually carry commercial supplements, such as high absorption carbohydrates and protein bars, which was expressed in FG IV: "It would be a good option; whenever I can, I take BCAAs and carbo gel".

In the view of McClung *et al.* (2020), designing ration menus that meet numerous military requirements (e.g., weight, volume, shelf life, and nutrient intake), all with similar priority, requires reasoning and skill. Having a higher ration fat content can be a partial solution because it allows for a more energy-dense ration (i.e., energy per unit volume). This characteristic favors the development of products with a smaller volume, meeting the military's desires and reducing individual logistical efforts.

Digestive difficulties aggravated by the profile of the hot and humid environment, causing the sensation of heartburn and indigestion, have also been reported. Due to the military profession profile, the absence of long rest intervals after eating should be considered. That is, after consumption, which is normally carried out in a short period of time, the military will be immediately ready for action, taking into account that the digestibility of the menu should not interfere with its performance. In this sense, the adoption of proteins with high digestibility would have a positive impact on performance and operability aspects, which is in line with the possibility of including fish in the diet.

Fish proteins are easily digestible and have a high biological value. Fats are rich in polyunsaturated fatty acids from the omega three series, which have reducing effects on blood cholesterol levels, decreasing the risk of vascular diseases (BRASIL, 2010). Still on digestibility, the military cited the lack of dietary fiber, as reported by a FG III participant, on the possibility of “inclusion of more fiber in the diet.” This finding was already mentioned in a study on the nutritional quality of operational rations, carried out by Barros and Koglin (2022), in which a lack of dietary fiber was found in three of the five menus offered. Adequate fiber intake is essential for the normal maintenance of the gastrointestinal tract and health, and it is important that this be part of the healthy population’s diet, reducing the risk of chronic degenerative diseases (CUPPARI, 2005).

It is worth mentioning the high technological quality involved in the product, confirming the testimony of FG II: “I consider it a safe product with good technological quality” in line with the results identified by researchers Avena and Ginani (2009), who concluded that the thermoprocessed meal is microbiologically safe.

As to the preparation for food consumption, the processes were considered adequate, allowing even tired soldiers to be able to correctly manipulate the preparation components. However, the excess of waste generated by packaging was profusely mentioned, in addition to the excess of waste resulting from the underconsumption of some items.

The participants (34.8%) mentioned considerations about the large volume of operational rations, making transportation and packing in backpacks difficult. As a proposal, the vacuum system could facilitate operations. Additionally, some participants (8.2%) mentioned the possibility of using packaging, with less environmental impact. Currently, only one ration component (cutlery) is derived from biodegradable components (BRASIL, 2022).

Thus, depending on the results presented, it is evident that research in the area of military food, with data collected from the assisted troops and their reading at the end of the line, is of great relevance and provide fundamental data for a better understanding of consumption, acceptance, and performance in the various operational and tactical niches, providing opportunities for continuous improvement in the quality of the items offered.

It should also be noted that the combination of electronic questionnaires and interviews in Focus Groups allowed participants to express, objectively and freely, their impressions about the product profile (operational ration) in the jungle environment, providing in-depth understanding and impressions about the entire feeding dynamics in the jungle environment,

and thus helping the design of strategies aimed at the development and/or reformulation of products and processes in the operational environment under study.

Finally, it is noted that this article has limitations due to both the sample size and the sampling used (non-probabilistic), and its results cannot be externalized to the country's entire military population, but, as evidenced, it opens opportunities for investigations in other regions, with more military personnel and other operational environments. In addition, one suggests that studies on the perception and consumption of menus should be performed in the field, for example, with ethnographic approaches.

#### **4 CONCLUSION**

The association of the tools employed (electronic questionnaire and focus groups) proved to be efficient to obtain information about general impressions, acceptability, and consumption of operational rations in the jungle environment. Despite all the excellent technology involved in existing products, the results showed profiles of monotony, nutritional deficit, little variety and low well-being in consumption, in addition to underconsumption and low acceptability of the main menus. In this context, the constant evaluation of the acceptability of the menus is suggested, providing opportunities for sensorial, nutritional and digestibility improvements, which guarantee the military's adequate energy and nutritional balance in the jungle environment.

Additionally, the possibility of inserting new processes and food products in the feeding routine was highlighted, and also of materials used in packaging, optimizing the combatant's operability and the military activity sustainability. Finally, given the importance of food for the performance and success of military exercise, it is recommended that similar studies should be reproduced in the most different operational environments, conducted in addition to observational on-site techniques.

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All authors had equal participation in the elaboration of this article.

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