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Socio-economic profile of the respondents of J&K and meat scientists of India for a study on lab-grown meat

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Abstract
The aim of the study was to evaluate the socio-economic profile of the respondents of the UT of J&K (scholars and professionals, n = 400) and meat scientists of India (n=51) for a study on lab-grown meat. The majority of the respondents from J&K were postgraduate scholars (70.82%) followed by the professionals in the Animal Husbandry (26.68%) and the Agriculture (2.50%) departments. The most respondents from J&K were male (54.25%) and 25-35 years old (71.50%). The majority ate meat (65.75%) with an average frequency of twice a week (40.50%). While most of the respondents from J&K were scholars (70.82%) and had no annual income, the majority of the professionals (82.02%) revealed an annual income of 6-12 lakhs. Among the meat scientists, 70% of the respondents were male and 30% were females. The majority of the scientists ate red meat (80%) followed by white meat (6.0%) whereas 14% of the respondents were vegetarians. Among the scientists, 34% consumed meat twice a week whereas 22% consumed thrice a week. Among the respondents from J&K, 17% supported lab-grown meat and chose it as the preferred meat whereas the majority (81.25%) preferred conventional meat. About 25% of the meat scientists supported lab-grown meat whereas the majority (49%) preferred conventional meat.

Keywords: Socio-economic profile, respondents, meat scientists, scholars, professionals, J&K, India, lab-grown meat

1. Introduction
In the upcoming years, the world population and along with it the demand for meat as a protein source are expected to grow (Bhat *et al.* 2023; Lee, 2018) [5, 11]. Scientists are looking outside of the realm of traditional agriculture to meet the higher demands for animal protein while simultaneously lowering the environmental impacts of production (Shapiro, 2018) [20]. Lab-grown meat, an innovation in cellular agriculture and food biotechnology, has been proposed as an alternative protein source. A variety of descriptors are used in the media and literature for this meat such as lab-grown meat, *in vitro* meat, synthetic, artificial and factory-grown meat (Bhat, Bhat, & Kumar, 2020) [3]. For consistency and lack of confusion, "lab-grown meat" will be the term used throughout this study. Lab-grown meat is grown in a laboratory using stem cells from a live animal (Bhat, Bhat & Pathak, 2014; Post, 2014) [2, 18]. The stem cells are placed in a culture medium and proliferated in a bioreactor (Lee, 2018) [11]. In the culture medium, the number of cells increases which differentiate into muscle fibres (Post, 2014) [18]. The muscle fibres can then be used to develop a meat product such as a burger patty or meatball (Post, 2014) [18].

It took more than 50 years to achieve the first cultured beef burger which was prepared in 2013 by the researcher Mark Post and his team from the University of Maastricht in the Netherlands (Bohm, Ferrari, & Woll, 2018) [6]. Since 2013, there has been a multitude of start-up companies all over the world with the goal of producing marketable lab-grown meat (Shapiro, 2018) [20]. Although this is a new technology, there is growing interest both from the public and the researchers. A U.S. online survey revealed that two-thirds of the consumers were willing to try lab-grown meat at least once (Wilks & Phillips, 2017) [23]. However, new concerns and problems have arisen with this technology. There is much deliberation about how lab-grown meat would be regulated if it were to be sold to the public. However, this concern was addressed when the U.S. Department of Agriculture announced the formal agreement for the USDA, Food Safety Inspection Service, and the U.S.

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Department of Health and Human Services' Food and Drug Administration to jointly regulate and supervise all products derived from the cells of livestock and poultry (USDA, 2019) [21]. If lab-grown meat becomes an item on the market, the FDA will monitor the collection, banking and growth of the cells (Campbell *et al.,* 2019) [7]. The USDA will be in charge of production and labelling of subsequent products (Campbell *et al.,* 2019) [7].

Controversy still exists over how lab-grown meat will be labelled. The Missouri Department of Agriculture passed legislation on August 30, 2018, that stated "products must include a prominent statement on the front of the package, immediately before or immediately after the product name" if the product is plant-based, veggie, lab-grown, lab-created or comparable (Public Statement, 2018) [19]. Not long after Missouri passed its law on labelling, South Carolina followed suit. The House and Senate unanimously passed a law for South Carolina that stated lab-grown meat could not be labelled as "meat" (Associated Press, 2019). The lawmaker and member of South Carolina's Cattleman's Association, Republican Rep. Randy Ligon stated he "doesn't want to stop research into the alternative food, but he does want to make sure consumers understand what they are getting," (AP, 2019). This new technology has sparked interest in the eyes of many technology innovators who see the potential it could have on society. Lab-grown meat start-ups are funded by people, such as Bill Gates, Jeff Bezos, Richard Branson, and former General Electric CEO Jack Welch all looking to be a part of this revolution in how we think of food, specifically meat (Shapiro, 2018) [20]. Not to be left out, Tyson, the world's largest producer of meat, has invested in two lab-grown meat startups, Memphis Meats and Future Meat Technologies (Min, 2019) [14]. Cargill has also been reported to have investments in lab-grown meat start-ups (Campbell, Felix, Hines, & Chiles, 2019) [7].

Producing meat in a laboratory would be more energy efficient, more environmentally friendly, and more humane than conventional animal husbandry practices (Penn, 2018) [17]. Animals in traditional production systems have low feed conversion ratios with cattle being around 15%, pigs at 30% and chickens around 60% (Post, 2014) [18]. Proponents state that lab-grown meat could be a more "resource-efficient" way to produce meat as protein (Post, 2014) [18]. Fewer animals in production systems would decrease greenhouse gas emissions as well as decrease the incidence of zoonotic diseases, such as bird flu and Spanish flu, as fewer people will be in contact with fewer animals (Shapiro, 2018; Post, 2014) [18, 20]. Lab-grown meat requires no feed inputs, 43.6 gallons of water, and less than a square foot of land to produce one pound of meat (Penn, 2018) [17]. New Harvest, a research institute dedicated to funding research on lab-grown meat stated "Cellular agriculture could be how we safely and sustainably feed our growing global population".

Proponents of lab-grown meat claim the technology would significantly decrease the environmental footprint compared to our current meat production systems. Some studies show cultured beef would decrease energy consumption by 45%

and land by 99% (Shapiro, 2018) [20]. However, a BBC article published in February 2019, summarized a study showing how methane is less harmful to the environment than carbon dioxide (greenhouse gas emitted from energy production used to grow lab-grown meat) (McGrath, 2019) [13].

However, if lab-grown meat could be produced cost-effectively, scientists hope the issue of feeding a growing population will be resolved (Wilks & Phillips, 2017) [23]. Meat has many problems and several of those problems are tied to technology and the industrialization of meat production which has led to increased stresses in animals, environments and people (Galusky, 2014) [9]. The analysis of consumer perception towards meat attributes is important to understand and predict their behaviour (Grunert, Bredahl & Brunso, 2004) [10].
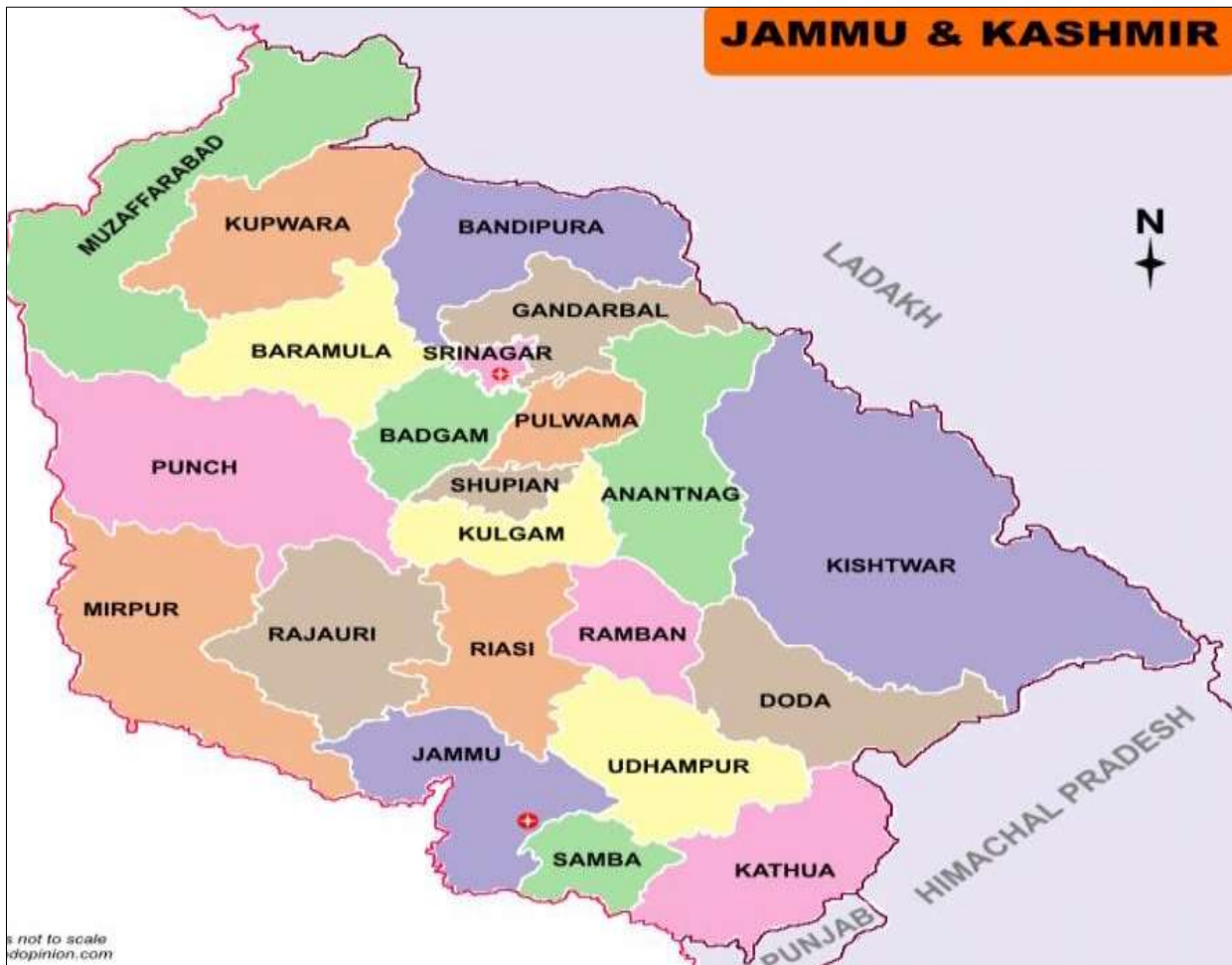
2. Materials and Methods
The present study was conducted in the union territory of Jammu and Kashmir (Fig. 1). The meat scientists (51) were selected from different states and union territories of India. Data were collected from the study area with the help of a pre-structured interview schedule after proper pre-testing and modifications. A multistage sampling plan was followed for the selection. Data was collected from respondents and selected by random sampling method. They were selected constituting a total sample size of 451. A total of 451 respondents were selected from the UT of J&K and India as shown in Figure 1 and Table 1.

3. Results and Discussion
3.1. Respondents from the UT of J&K
The respondents of the present study belonged to the Union Territory of Jammu and Kashmir. The respondents selected were between the age of 21-38 years. Most of the respondents (11.50%) were 25 years old and the majority of them were male, 54.25%. The minimum educational qualification of all the respondents was found to be graduation level whereas it was observed that the majority of them were unemployed (74%). Of the employed respondents, the maximum income group was between 10-11 lakhs constituting about 25.84% of the total sample followed by 11-12 lakhs (16.85%) whereas the least income group was between 6-9 lakhs which constituted 3.37% of the total sample size. The data on the current eating habits of the respondents was also collected and the analysis of the data revealed that out of the total 400 respondents, the majority (65.75%) were meat-eating of which 40.50% consumed meat twice a week, 27.25% consumed meat thrice a week and 5.50% consumed meat daily. It is important to note that the majority (65.75%) of the respondents preferred red meat over white meat despite their high awareness of the negative impact of red meat on human health and the growing evidence against red meat consumption (Bhat *et al*. 2023, 2019; Papier *et al*. 2021) [4, 5, 16]. Similar results were found during a national survey conducted in Sweden in 2020 when the majority (75%) of the respondents were unwilling to change their annual meat intake (Collier *et al*. 2021) [8].

Fig 1: Data was collected from respondents and selected by random sampling method. A total of 400 respondents were selected from Jammu & Kashmir. In addition, the meat scientists (51) were selected from different states and union territories of India.

Table 1: Selection of the respondents

	Respondents of J&K	Meat scientists
Number of the respondents (n)	400	51
Region of the study	UT of Jammu and Kashmir	India

3.2. Meat Scientists of India
The study included 51 meat scientists who held positions as research scientists or faculty members (professors, associate professors and assistant professors) in 23 different universities and research institutes in India. The majority of the meat scientists were male (70%) and were in the age group of 35-60 years. About 6% of meat scientists ate meat at least twice a month, 18% at least once a week and 34% at least twice a week. It is important to note that the majority (80%) of meat scientists preferred red meat over white meat despite their high awareness of the negative impact of red meat on human health and the growing evidence against red meat consumption (Bhat *et al*. 2019; Papier *et al*. 2021) [4, 16]. This indicates that majority of the meat consumers are unwilling to give up red meat or meat even if they are well-informed and fully aware of its negative health and environmental effects. Despite high awareness of the negative effects of meat consumption on the environment and animal welfare, consumers are generally unwilling to give up meat (May and Kumar, 2023) [12]. Just because consumers accept ethical arguments does not always mean that they are motivated to change their food habits. Similar results were found during a national survey conducted in Sweden in 2020 when the majority (75%) of the respondents were unwilling to change

their annual intake of meat (Collier *et al*. 2021) [8]. Not only are Americans unwilling to give up meat but the sale of plant-based meat alternatives has recently slowed down in the USA due to their low health benefits, bad taste, and high prices (Osaka, 2023; Young *et al*. 2022) [15, 24].

4. Conclusions
Our results indicated that the majority of the respondents from J&K were postgraduate scholars (70.82%) followed by the professionals in the Animal Husbandry (26.68%) and the Agriculture (2.50%) departments. The most respondents from J&K were male (54.25%) and 25-35 years old (71.50%). The majority ate meat (65.75%) with an average frequency of twice a week (40.50%). While most of the respondents from J&K were scholars (70.82%) and had no annual income, the majority of the professionals (82.02%) revealed an annual income of 6-12 lakhs. Among the meat scientists, 70% of the respondents were male and 30% were females. The majority of the scientists ate red meat (80%) followed by white meat (6.0%) whereas 14% of the respondents were vegetarians. Among the scientists, 34% consumed meat twice a week whereas 22% consumed thrice a week. Among the respondents from J&K, 17% supported lab-grown meat and chose it as the preferred meat whereas the majority (81.25%) preferred conventional meat. About 25% of the meat scientists supported lab-grown meat whereas the majority (49%) preferred conventional meat. Future studies should evaluate the acceptance and perception of educated and professional consumers of India about cultured meat.

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