Oat Hull Fiber & Fat Reduction

The lower fat and lower calorie diet trend is going strong, with 53.5 % of US consumers considering the low-fat diet the healthiest. Of those consumers, 21.9% associate a medium low-fat diet as the healthiest alternative.[1]

So what's a healthy, viable solution for bakers? Oat hull fiber can reduce the fat content in baked goods, without a loss in quality. In fact, it is a highly functional ingredient within food systems.

How is it different than oat bran fiber?

Oat bran fiber can be derived from the edible covering of the groat. This fiber is dark brown and has a rich flavor. On the contrary, oat hull fiber has mild flavor and color. Additionally, oat bran fiber is mainly made up of soluble fiber, compared to oat hull fiber which is mostly insoluble fiber.

Why Bake with Oat Hull Fiber?

Oat hull fiber is abundantly available in North America and is a rich fiber source. It is an ingredient obtained by grinding and purifying the outermost protective non-digestible mixed plant cell wall fiber of the oat grain.[2] Oat hull fiber is an FDA approved insoluble dietary fiber. It consists mainly of lignin, cellulose, and hemicellulose and contains up to 90% of insoluble dietary fiber.[12] Oat hull fiber has great nutritional and functional benefits, such as improving GI functions. In baked goods, this fiber improves the crumb softness and texture by absorbing high amounts of lipids and water.

Modern oat is believed to have its origins as red oat. The red-oat was considered a weed in Asia that grew around 2000 BC. Before being used as food, oats were used for medicinal purposes in Asia and southeast Europe. These uses included protection against cancers and heart disease, enhancing the immune response to infection, stabilizing blood sugar, and other ailments, as well as use as an antispasmodic, diuretic, emollient, nerve tonic, supplement, aphrodisiac, and stimulant.[5,6,7,8]

PROCESSING OF OATS THROUGH TIME

Modern oat cultivation originated in the middle eastern Mediterranean and was brought to North America by Scottish settlers. The cultivation in North America dates back to the 17th century. One of the oldest cultivated crops, it flourished in the US and several European countries. White oat accounts for the major share among all oat species. Newer cultivars are currently bred for their unique functional properties.

Oat Hull Fiber Production Flow Chart

The production of oats on the farm through typical oat-processing operations and production of human foods to the industry level.

Environment
soil, sun, water

NON-DIGESTIBLE SEED

Agronomical
variety, fertilizer

CLEAN & GRADE

Hull Grinding

OAT HULL FIBER

DEHULL

HEAT / DRY

Porridge

CUT / FLAKE / GRIND

Further Processed Foods
ready-to-eat breakfast cereals, baked goods & fiber extraction

OAT BRAN FIBER
grinding peripheral layer of oat groat

Benefits of **Oat Hull Fiber**

It is possible to utilize oat hull fiber for several different functions such as:

1 Fat Replacement

Oat hull fibers mimic the textural properties of fats and works as a fat replacer. It increases the crumbling texture of pastries. The fiber can thicken the batters and marinades by water absorption. It can absorb up to 300 times its weight for high and low moisture foods.

2 Shelf-life Extension

The high water absorption properties increase shelf life and delay product staling. The crispy or crunchy quality of foods, such as tortilla chips and crackers, can be preserved as oat hull fiber reduces the friability and breakage.

3 Clean Label Ingredient Replacement

Oat fiber can also completely or partially replace the functionality of other ingredients to work as a clean label substitute for gums and anti-caking agents. Oat hull fiber works as an anti-caking agent due to a higher water absorption capacity along with moderating water retention capability. As an ingredient replacement, it helps with cost-reduction while improving or maintaining the textural and mouthfeel properties in a clean label formula.

FUNCTIONAL BENEFITS OF OAT HULL FIBER

- Natural, clean-label ingredient available as organic and gluten-free
- Insoluble dietary fiber for bread, snacks, cereals, and bars
- Low in calories
- Breakage reduction in tortillas, cereals, snacks, croutons, chips, etc.
- Shelf-life extension and increased moisture retention and rollability in flatbread, tortillas, pizza, and more
- Improved texture and crispiness
- Hydrocolloid/gums replacement

CLAIMING HIGH FIBER & GOOD SOURCE OF FIBER

The daily reference value (DRV) provided by FDA for dietary fibers is 28g.[5] A product containing 20% of the fiber DRV can be claimed as a “high fiber" product.[4] A product with 10-19 % can claim good fiber content. Oat hull fiber is noted under the FDA Compliance Title 21 CFR 101.9(c)(6)(i).

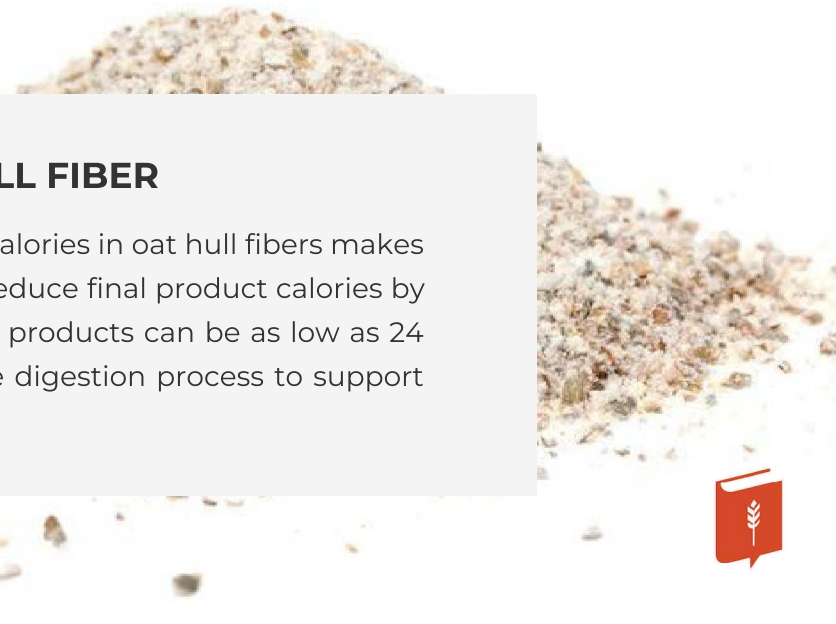
MODIFY YOUR FORMULATION FOR OAT HULL FIBER

Some studies found oat fiber powder in sponge cake along with flour and claims 20% replacement has beneficial effects. Further increasing the fiber concentration without increasing water content results in a harder sponge.[9] Another article showed that increasing the fiber content in bakery products such as bread results in better color and rheological properties.[10]

Both articles discuss the importance of altering the product water content based on the fiber's water holding capacity and simply replacing the commercial wheat flour with oat hull fibers.

WHEN REFORMULATING WITH OAT HULL FIBER:

1. An additional step from conventional baking practices is required where fibers are prehydrated. It is important to reach maximum water holding capacity (optimum gelling). It is also possible to add oat hull fiber to pre-fermentation in the ferment and adding it later to the flour. The fiber behavior at optimum gelling capacity can be compared with hydrocolloid behavior.
2. It is worth noting to use small-sized fibers (5- 20 microns) to ensure a good aspect ratio (length:width) for form a gel. The high surface area increases result in a better gelling property.
3. The large size fibers, more than 75 microns, do not lose the characteristic taste and other microscopic attributes of oat. As a result, the sensory properties of the final product often gives a chemical/cardboard taste.



NUTRITIONAL BENEFITS OF OAT HULL FIBER

Compared to other baking ingredients, the low calories in oat hull fibers makes it an effective calorie controller. It is possible to reduce final product calories by replacing fat and hydrocolloids with fiber. Some products can be as low as 24 kcal/100g. The swelling property further aids the digestion process to support good gastrointestinal health.

How does oat hull fiber to extend product shelf life?

Fibers have a higher water holding capacity which increases the water-holding properties of the system. This decreases the bake out of the product, and hence, leaves more water in the system to prevent staling. This is why the use of oat hull fiber may improve the softness of your product over longer shelf life.

How can I add oat hull fiber to a cake formula?

While it does seem odd, there is a reason for doing this. Many bakers looking for emulsifier replacement and fat reduction can look to adding oat fiber in cakes. A replacement of 20% commercial wheat flour partial replacement can be achieved with no alteration in sensory properties.[9]

It can especially be used for gluten free product development which could include oat fiber, rice flour, and inulin as shown in the table below. The best results in the given results were achieved in the case of oat-inulin formulation followed by oat-guar formulation.[9]

How much additional water should be added when using oat fiber?

The additional water to be added depends on the water holding capacity of the fiber. This can easily be compensated by the hydration of fibers reaching a gelling. Depending on the type of fiber, this can be up to 200-300 times their weight.

If I add up to 10% oat fiber to whole wheat sandwich bread, how will it affect dough hydration?

It is recommended to reach the fiber's optimum gelling capacity (maximum water holding condition for fiber). This can be later added to the final product. In conditions where pre-fermentation is possible, like bread, the fiber can be put in the ferment and later mixed with the flour.

What about the arrival time and the amount of moisture that needs to be baked off with high fiber bread?

The additional moisture is usually bound by the fiber in case of pre hydration. It should not affect arrival time. Due to the increase in absorption, a longer baking time is necessary in high fiber bread.

References

1. Lusk J. L. (2019). Consumer beliefs about healthy foods and diets. PloS one, 14(10), e0223098. https://doi.org/10.1371/journal.pone.0223098
2. Review of the Scientific Evidence on the Physiological Effects of Certain Non-Digestible Carbohydrates
3. NFL DRVs Food Components
4. CFR - Code of Federal Regulations Title 21 Whole Grains Bureau. Accessed 4/14/06. History of Whole Grains.
5. Williams, John K. (2003) A Brief History of Oats - And How You Should Eat Them. Accessed 4/14/2006.Plants For A Future (2000). Accessed 4/15/06. Avena sativa.
6. Plants for a Future, Blagdon Cross, Ashwater, Beaworthy, Devon, EX21 5DF, UK.
7. North American Millers' Association(2000). Oat foods: A smart choice. Retrieved April 14, 2006.
8. Whole Grains Bureau. Accessed 4/14/06. History of Whole Grains.
9. Majzoobi, M., Habibi, M., Hedayati, S., Ghiasi, F., & Farahnaky, A. (2018). Effects of commercial oat fiber on characteristics of batter and sponge cake.
10. Kurek, M., Wyrwisz, J., Piwińska, M., & Wierzbicka, A. (2016). The effect of oat fiber powder particle size on the physical properties of wheat bread rolls. Food Technology and Biotechnology, 54(1), 45-51.
11. Paschoal, G. B., Muller, C. M., Carvalho, G. M., Tischer, C. A., & Mali, S. (2015). Isolation and characterization of nanofibrillated cellulose from oat hulls. Quimica Nova, 38(4), 478-482.